

Historic, Archive Document

Do not assume content reflects current scientific knowledge, policies, or practices.

A386N2
R

NATIONAL PULP AND PAPER
REQUIREMENTS IN RELATION TO
FOREST CONSERVATION

LETTER
FROM
THE SECRETARY OF AGRICULTURE

TRANSMITTING

IN RESPONSE TO SENATE RESOLUTION No. 205
(73D CONGRESS) A REPORT ON NATIONAL
PULP AND PAPER REQUIREMENTS
IN RELATION TO FOREST
CONSERVATION



MAY 13 (calendar day, JULY 15), 1935.—Referred to the
Committee on Agriculture and Forestry and
ordered to be printed with illustrations

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1935

CONTENTS

	Page
Conclusion.....	1
Volume of pulpwood, pulp, and paper imports.....	1
Forests of the United States could supply present requirements with known processes.....	2
Adjustments which would be required and program of forest conservation recommended.....	2
Properly planned national self-sufficiency would stimulate forest conservation.....	4
Related economic considerations.....	5
Reduction of imports might mean reduction of exports.....	5
Offsetting considerations.....	6
Foreign trade.....	6
Foreign pulpwood supplies not unlimited.....	7
Pulp and paper industry.....	7
Forest conservation.....	8
Recommended policy.....	8
Present and prospective paper, pulp, and pulpwood requirements.....	9
Paper and pulp requirements.....	9
Wood most important raw material in paper manufacture.....	10
Dependence on imports for paper and pulp requirements.....	10
Pulpwood requirements.....	13
Use of wood pulp in various paper grades.....	14
Importance of spruce as pulpwood.....	16
Spruce holds place despite increasing use of other pulpwood.....	16
Possibilities of broader species use.....	18
Newsprint from southern yellow pines.....	18
Prospects of wider use of hardwoods.....	19
Bleached sulphate possibilities.....	20
Soda base sulphite pulping.....	20
Deinking of old newspapers.....	21
Modified pulping processes.....	21
Trends of paper consumption.....	22
Newsprint.....	24
Books and fine papers.....	24
Boards.....	24
Wrapping and all other grades.....	24
Rayon and cellulose films.....	24
Possible future pulpwood requirements.....	25
Potential ability of the forests of the United States to meet pulpwood requirements.....	26
Pulpwood for newsprint paper requirements.....	27
Older regions hard pressed to maintain newsprint production.....	29
Pacific coast and Alaska have large potential production.....	30
Prospective development of newsprint industry in South.....	31
Summary of newsprint situation.....	31
Pulpwood for mechanical and sulphite processes as a whole.....	31
Utilization of hardwoods can sustain production of older regions.....	33
Summary of mechanical and sulphite pulp situation.....	35
Pulpwood for the sulphate process.....	35
Pulpwood for soda and semichemical process.....	37
Pulpwood for all pulp processes.....	37
South and Pacific coast regions dominate prospective future production.....	38
Existing pulp-mill capacity in relation to current paper and pulp consumption.....	41
Prospective pulpwood production in relation to location of paper mills.....	41

Forestry measures which would be required to meet pulpwood and other timber requirements.....	Page 42
Pulpwood supply an integral part of general forestry problem.....	42
Existing growing stocks generally inadequate.....	44
Wide-spread application of scientific forest management would be required.....	47
Conservative utilization will help.....	47
How meeting of pulpwood requirements will aid in conservation program.....	48
Advantage of integration of forest industries.....	50
Pulp and paper industry cannot be dependent upon lumber industry.....	50
Pulp industry may reduce wood costs by sale of sawlogs.....	51
Pacific coast points way for South and Northeast.....	52
Summary of forestry situation.....	52
Social and economic aspects.....	53
Benefits of independence in pulpwood supplies.....	53
Economic utilization of land.....	53
Opportunities for direct employment.....	53
Stability of communities.....	54
Aid to agriculture.....	54
Regional competition.....	55
Recommendations for forest conservation.....	58
Public action.....	59
Research.....	59
Public ownership of forest land.....	60
Adequate protection and equitable taxation.....	60
Extension of knowledge of forest management.....	60
Control of timber cutting operations.....	60
Action by industry.....	61
Related considerations concerning foreign trade.....	62
United States now a creditor nation.....	62
Increased imports sought to sustain export trade.....	63
Readjustment of agriculture will help.....	64
The place of pulp and paper in foreign trade of the United States.....	65
Commerce of the United States with Canada.....	66
Commerce of the United States with Sweden and Finland.....	68
Balance between production of pulpwood and agricultural crops.....	68
Foreign sources of pulp and paper may become inadequate.....	70
World paper consumption increasing.....	70
World timber supplies diminishing.....	71
Independence will afford stability to domestic industry and assurance of adequate future supplies.....	73
Long range planning required.....	73

LETTER OF TRANSMITTAL

DEPARTMENT OF AGRICULTURE,
Washington, D. C., July 12, 1935.

THE PRESIDENT OF THE UNITED STATES SENATE.

SIR: I have the honor to submit herewith a report entitled "National Pulp and Paper Requirements in Relation to Forest Conservation", prepared by the Department pursuant to Senate Resolution 205 (73d Cong., 1st sess.), introduced by Senator Frederick Hale.

Whether the United States can meet present and possible future requirements for pulpwood, pulp, and paper resolves itself into two questions.

The first involves physical factors, the growing of pulpwood and the availability of pulping processes. Under adequate forest management the answer is unquestionably, "yes."

The second involves competitive factors. Although a period of stiff competition appears inevitable, it seems probable that in the long run we should be able to meet foreign competition successfully, especially since increasing world consumption may be expected to exert greater pressure on diminishing timber supplies in most exporting countries.

Expansion of the pulp and paper industry with commensurate provision for growing the necessary pulpwood would advance the national program of forestry. It may well be coordinated with the production of saw timber on a sustained-yield basis and might eventually contribute directly toward productive use from 100 to 200 million acres of forest land. Indirectly it might affect the use of the entire 500 million acres of commercial forest area. Without the incentive for proper forest management which prospective markets through established wood-using industries afford to capital, private forest lands will tend to become or remain nonproductive. Pulp and paper industries cannot be supported indefinitely without sustained-yield forest management, but on the other hand, a national forestry program must depend upon stable industries to utilize its products.

Expansion of the pulp and paper industry might also contribute beneficially toward social and economic security in a number of ways. It might provide substantial support for rural-industrial communities in several sections of the country; it might aid agriculture by affording farmers a market for their woodland products and otherwise; it might provide a much needed source of industrial employment; and it might be an important factor in land use plans and adjustments. But to the extent that imports are cut off, these benefits may be offset by resulting losses of foreign markets and reduction in opportunities for employment in production for export, both in agriculture and industry.

Whether it would be for the best interest of the country to become completely self-sufficient in wood pulp and paper, or whether it would be best to continue to import part of our requirements in exchange for commodities we export, cannot be accurately forecast at this time. The Government is now engaged in trade negotiations aimed at restoration of our previous export trade in farm and industrial products as directed by Congress in the Reciprocal Tariff Act. Worthwhile results have already been accomplished and these efforts to reestablish trade should be continued.

In view of these considerations, it does not seem wise to recommend that the United States strive to become fully self-supporting in paper and pulp requirements. But since forests can neither be organized nor industries established over night, the highest public interest requires that a far-sighted national policy, which will conserve and restore the productivity of our forests, be outlined and pursued so that the Nation will not be unprepared for possible future needs.

All things considered, the safest course seems to be to go ahead with the national program of forestry as presented in Senate Document 12, Seventy-third Congress, first session, which will require several decades to become fully effective, to give every public countenance and encouragement short of subsidy or tariff to the development of the American pulp and paper industry and to place no obstacles in the way of replacement of existing imports by the domestic industry in open competition.

Sincerely yours,

H. A. WALLACE, *Secretary.*

NATIONAL PULP AND PAPER REQUIREMENTS IN RELATION TO FOREST CONSERVATION

By C. E. CURRAN, *in charge pulp and paper section, Forest Products Laboratory*,
and C. EDWARD BEHRE, *director Northeastern Forest Experiment Station*¹

CONCLUSION

Senate Resolution 205 (73d Cong., 2d sess.), in response to which this report has been prepared, reads as follows:

Resolved, That the Secretary of Agriculture be, and he is hereby, requested to submit to the Senate at his early convenience a report based on information already available covering—

(a) The extent to which the United States now depends upon imports of pulpwood, pulp, and paper to meet national requirements;

(b) Whether and the extent to which it is now possible with known pulp and paper processes to supply from the forest lands of the United States all of the pulpwood needed to meet the national pulp and paper requirements;

(c) What adjustments are feasible and necessary and what program of forest conservation is recommended for the immediate and more distant future by the Federal Government, the States, the pulp and paper industry, and private owners of forest lands to make the United States self-supporting in its pulpwood, pulp, and paper requirements; and

(d) Whether it would advance or retard the program of forest conservation to make the United States self-supporting as to pulpwood, pulp, and paper requirements from American forests.

The resolution deals primarily with the possibility of making the United States self-supporting in pulpwood, pulp, and paper, considering manufacturing processes and the productive capacity of our forests. It calls specifically for a program of self-sufficiency for the United States, and asks whether such a program would advance or retard forest conservation. It also asks what adjustments to this end are feasible and necessary and this implies consideration of related elements of national well-being.

VOLUME OF PULPWOOD, PULP, AND PAPER IMPORTS

The United States consumes around 11,000,000 tons of paper annually. This requires over 12,000,000 cords of pulpwood.

More than 50 percent of these requirements are imported as paper, pulp, or pulpwood, mainly from Canada, Sweden, and Finland.

Imports of paper, almost wholly newsprint and nine-tenths from Canada, total nearly 2,000,000 tons annually. Wood-pulp imports aggregate almost 2,000,000 tons, about 60 percent being sulphite, almost 30 percent sulphate, and the remainder mechanical. Soda pulp imports are negligible. Finally, about three-fourths of a million cords of pulpwood are imported, practically all from Canada. In terms of the pulpwood equivalent, paper constitutes around 35 percent of the imports, wood pulp around 50 percent, and pulpwood the remainder, of 15 percent.

¹ W. H. Gibbons and R. V. Reynolds assisted in the preparation of statistical material and in review of the manuscript. Acknowledgment is also due to C. W. Boyce, executive secretary American Paper & Pulp Association for cooperation in furnishing data on the industry and for permission to use material from his earlier publications.

The value of all paper, wood pulp, and pulpwood imports was \$140,207,883 in 1933. Of this total 55 percent was represented by paper, 41 percent by wood pulp, and only about 4 percent by pulpwood.

FORESTS OF THE UNITED STATES COULD SUPPLY PRESENT REQUIREMENTS WITH KNOWN PROCESSES

The forests of the United States could supply present pulp and paper requirements and this could be done with pulp and paper processes now in commercial use. If national needs for lumber and other forest products were also to be met, permanence could only be assured by sound forestry practices on both private and public forest lands.

Expansion of the domestic pulp and paper industry to provide for national self-sufficiency would have to take place primarily in the South, the Pacific Northwest, and to a lesser extent in Alaska, rather than in the northeastern and lake regions where it has until recently been concentrated. This would involve a substantial broadening of the base of species used, a trend already much in evidence.

ADJUSTMENTS WHICH WOULD BE REQUIRED AND PROGRAM OF FOREST CONSERVATION RECOMMENDED

Major dependence on imports has developed largely as a result of long-standing preference for spruce, which is peculiarly suited for newsprint paper, and for sulphite and mechanical pulps which comprise about 75 percent of total requirements.

Exclusive need for spruce for mechanical and sulphite pulps has greatly diminished as a result of technical developments. Balsam fir in the East, and other true firs and hemlock in the West are now used in place of spruce with little discrimination, while many hardwoods are similarly used on a limited scale. The ability to use western hemlock has opened the way for extensive development of the pulp and paper industry on the Pacific coast and in Alaska. Research developments point clearly to the extension of the mechanical and sulphite processes to other important native species, notably the southern yellow pines, and to the possibility of a wider use of hardwoods.

Furthermore, pulps manufactured by the sulphate process are rapidly increasing in importance and are being adapted to many purposes formerly supplied only by sulphite pulp. Since sulphate pulp can be made from almost any coniferous species, this indicates a further movement away from the dominance of spruce-fir-hemlock.

A program to make the United States self-supporting in paper and pulp would need to take care of possible future as well as present requirements. There is reason to believe that total future requirements 15 or 20 years hence may be double present consumption. Study of the trends in paper consumption by grades indicates that a possible total of 24,000,000 tons of paper, or pulpwood requirements of 25,000,000 cords a year, would be a reasonable basis if plans were to be made for national self-sufficiency.

Self-sufficiency in present requirements would necessitate a doubling of pulpwood production but only increasing paper production about 20 percent; future requirements would necessitate increasing paper

production more than 2½ times and quadrupling the output of pulpwood.

With the broadening of species used and adaptation of processes such as those already mentioned, pulpwood requirements, even for prospective consumption, could be supplied from the forests of the United States, but this would require vigorous prosecution of a comprehensive forestry program.

The forestry problem involved would not be difficult if pulpwood requirements could be considered independently. But the production of pulpwood cannot be isolated from that of other forest products, and the integration of the growing of timber for lumber and pulpwood should be an important element in a national program of forestry. With such integration, the manufacture of lumber could be restricted to the larger-sized material most economical for this purpose, and pulp mills could utilize the smaller woods material and sawmill waste. In addition, pulpwood would be available from thinnings and other silvicultural operations which would stimulate the production of high-quality sawtimber. If the costs of growing the timber could be borne largely by the sawlogs, the cost of pulpwood would be low. Even on areas where pulpwood might be the major objective of management, growing the timber to relatively large size with selective cuttings at relatively short intervals would probably be the most economical practice.

In any event the possible benefits from meeting pulp and paper requirements would be short-lived and questionable if expansion of the pulp industry involved sacrifices of other forest industries and did not include measures to perpetuate the forest resources. Any new developments in the pulp and paper industry would need to be planned in relation to an assured and permanent supply of low-cost raw material, and this would imply a program of sustained-yield forest management correlated with requirements for other forest products.

Both as to intensity of husbandry and extent of application, present practices in forest management are so far short of what would be needed to meet prospective requirements for all forest products that intensive Nation-wide efforts through both public and private agencies, would be necessary to approach permanent self-sufficiency. Only a program which applied to the forest lands of the Nation as a whole could achieve such an end; without this, there would be no assurance of complete and permanent control of any part of the land, which would be necessary if pulp were to be considered alone.

Research would be needed in all phases of forest management and utilization to insure successful solution of the many technical problems involved in the realization of such a program. Research should open the way for wider use of a larger number of species for pulp, make possible the manufacture of better paper at lower cost, and develop the basis for scientific forest management which would assure economic production of an adequate and continuous supply of raw material.

Proper handling of pulpwood growing and timber cutting operations on privately owned land would require public assistance and also some form of public control adequately to safeguard the public interest in forest conservation. Public assistance should be not only through such direct measures as extension of knowledge of forest

management, protection of forests from fire, insects, and disease, and equitable taxation, but also indirectly through a large-scale program of public acquisition of forest lands.

As a minimum in public control of timber cutting on privately owned lands such Nation-wide cooperative action as was contemplated under the conservation article of the lumber code and proposed in the pulpwood code might suffice. But adequate results would be more certain under basic legislation applicable to all private forest lands and to all wood-using industries.

The program recommended in "A National Plan for American Forestry", Senate Document No. 12, Seventy-third Congress, first session, would make the United States self-supporting in both its present and probable future pulpwood, pulp, and paper requirements as well as in other forest products. The proper place of forestry in a consistent national program of land use is also discussed in the report by the National Resources Board, part II, Report of the Land Planning Committee.

PROPERLY PLANNED NATIONAL SELF-SUFFICIENCY WOULD STIMULATE FOREST CONSERVATION

Permanent self-sufficiency in both present and prospective pulpwood, pulp, and paper requirements would materially advance a national program of forest conservation.

The utilization of pulpwood would permit the conversion of small-sized material into relatively high-priced products. Conversely, production of pulpwood as an integral part of a comprehensive program of forestry ought to supply abundant raw material for paper manufacture at relatively low cost.

But of perhaps greater significance is the fact that stable outlets for forest products through established industries, such as pulp and paper manufacture, offer the strongest incentive to sustained yield forest management on privately owned forest lands. Without this incentive private ownership will not be interested in forest conservation and the burden of maintaining forest lands would have to be borne largely by the public.

Satisfaction of prospective pulp and paper requirements of 25 million cords of pulpwood annually would contribute directly to the effective use of from 100 to 200 million acres of forest lands, and in providing for all timber products this would indirectly affect the use of the entire 500 million acres of commercial forest land.

An essential feature of forest conservation is the contribution which it can make to economic and social well being.

Self-sufficiency in paper requirements for the future would provide employment for about 243,000 more people than were engaged in the pulp and paper industry in 1929, and would contribute economic stability to a large number of communities in many sections of the country. It might serve to ameliorate conditions in agriculture by providing a steady source of cash income from farm woodlots and a use for submarginal parts of farms, by offering part-time employment to farm labor, teams and trucks, and by otherwise indirectly raising the standard of living in rural sections. On the other hand, substitution of domestic pulp for imported pulp and paper would reduce foreign purchasing power for our exports, and thereby tend to

reduce employment in farming and manufacturing industries dependent upon exports. No definite estimates can be made as to how large these indirect costs of self-sufficiency would be.

RELATED ECONOMIC CONSIDERATIONS

While, in compliance with the resolution, the preceding summary deals with forest conservation and national self-sufficiency in pulpwood, pulp, and paper, the problem is so intimately related to other aspects of national policy that other economic factors require consideration. An immediate attempt to establish national self-sufficiency in these products would not be consistent with policies of the administration for restoration of foreign trade, especially in agricultural products. It is therefore necessary to consider the possible disadvantages of self-sufficiency as well as its possible advantages.

REDUCTION OF IMPORTS MIGHT MEAN REDUCTION OF EXPORTS

American products exported must be paid for in dollars. Foreigners can obtain the dollars only by selling goods or services to us, borrowing them from us, or shipping us gold or silver. The last two processes cannot be carried on indefinitely; foreign trade based on continual new loans has already been largely abandoned. Any reduction of our commodity imports, therefore, is likely to cause a corresponding displacement in commodity exports.

This relationship is the background for the following considerations:

1. The United States has been a creditor nation since the World War. The most effective if not the only way to enable foreign countries to pay their debts is to maintain or build up imports.

2. Policies of extreme nationalism, which attempted to maintain export markets and yet build up barriers and otherwise refused to accept commensurate imports, have been an important element in the severity of the depression. The foreign trade of the United States in 1933 shrank to only one-third of its 1929 value, agriculture suffering relatively more than industry. The crop reduction program of the Agricultural Adjustment Administration is the result of this narrowed foreign market. Reduction of trade barriers and encouragement of imports should be effective in maintaining and increasing exports and in restoring prosperity, and should be an important phase of national policy.

3. The profitable use of large areas of agricultural lands may depend upon the successful disposal of the exportable surplus of major agricultural crops, especially cotton. This in turn depends in no small degree on the maintenance of a large volume of imports.

4. Full utilization of the large industrial plant capacity of the United States may also depend in part upon exports which can best be encouraged by maintaining or building up the purchasing power of foreign countries through imports.

5. Cessation of pulp and paper imports accordingly might impede recovery and might cause additional unemployment in those portions of agriculture and industry dependent upon exports.

6. Newsprint paper, pulp, and pulpwood together constitute a major item in our trade with Canada, and pulp with north European countries. Replacement of these imports may involve far-reaching

economic disturbance, and may add to the problems of agricultural adjustment. Their increase might stimulate our agricultural and industrial exports.

7. American forest lands and the American pulp and paper industry may not be able to compete in price and quality with foreign products, and it might be a wiser national policy to purchase these products with the export of others that can be grown or manufactured more economically at home.

OFFSETTING CONSIDERATIONS

In arriving at a solution which will be in the highest public interest such factors as those indicated above must be weighed against the following:

FOREIGN TRADE

1. The Secretary of Agriculture has suggested that ability of foreign countries to purchase our goods be built up by removing or lowering tariffs on products which are manufactured only in small quantities in the United States and on those which are produced here under monopoly or so ineffectively that tariffs exceed 50 percent ad valorem. The United States imposes no tariff barriers on pulpwood, pulp, or newsprint paper, and imports of other grades of finished papers, on which moderate tariffs are imposed, are very small. These products therefore offer little or no opportunity to make concessions which will stimulate foreign purchasing power, although agreeing to keep them on the free list does have an important place in reciprocal trade negotiations. Foreign purchasing power for American products depends not only on our imports of goods but also on expenditures of American tourists abroad, remittances of immigrants, expenditures for foreign shipping, etc. Foreign trade may also be influenced by manipulation of currencies. However, commodity imports is by far the most important item. Reduction of imports may offset any improvement in the other factors. If they remained unchanged while less was imported, exports would have to be reduced correspondingly.

2. Sweden and Finland together, the two most important European countries from which pulp and paper imports are received, take less than 2 percent of American agricultural exports. Furthermore Sweden has no debts in this country and Finnish debts here are relatively small. Reduction of trade with these countries cannot exert any large direct influence on our agriculture; though it might exert an indirect effect through reducing our industrial exports. Canada, from whom we obtained over 62 percent in value of all our paper, pulp, and pulpwood imports in 1929, took 9 percent of our agricultural exports in that year and about 6 percent in 1933. Pulpwood, pulp, and paper rank high among the products which Canada, Sweden, and Finland can export to the United States, and through multilateral relations their trade with us may have more significance to our agriculture than indicated by what they take directly.

3. Under the existing conditions, the United States must think in terms of curtailed foreign outlets for our agricultural products, which have been important factors in foreign trade; but it must weigh carefully any new proposal which might still further narrow export markets.

The Department of Agriculture has pointed out the possibility and desirability of adjustments in crop production within and between regions which, although still in need of study, may help to solve the problems of reduced foreign markets. In several regions, such adjustments would include the use of submarginal crop lands for timber growing and the development of industries, such as pulp and paper manufacture, which will furnish markets for the products. In other regions they would involve using for range and livestock, lands now devoted to wheat.

FOREIGN PULPWOOD SUPPLIES NOT UNLIMITED

4. A comparatively small change in either American or world markets might make the United States a competitive buyer for limited supplies of foreign pulp and paper instead of a competitive market for ample world production as at present.

Except during the recent depression, American paper consumption has increased rapidly and without a break, and that for the rest of the world more slowly, for more than a century. Many considerations indicate that the saturation point has not been reached.

Of the five countries which offer any large possibilities of supplying world markets, Canada is cutting far in excess of annual growth and operations are becoming more remote and costly. Newfoundland is also cutting in excess of annual growth and probably cannot increase her production much more. Russia is rapidly dissipating its easily accessible timber, and although exporting pulpwood under pressure, will probably require its own pulp and paper output for many decades. Although forest management in Sweden and Finland is on or approaches a sustained yield basis, the chief possibility for further increase in exports from these two countries is through diversion of a larger proportion of forest products from lumber or fuel wood to pulp and paper.

5. Higher prices for foreign pulp would place paper mills dependent upon imported pulp at a disadvantage as compared to domestic self-contained mills since their ability to compete depends upon a stable supply of low-cost raw material.

PULP AND PAPER INDUSTRY

6. While the American pulp and paper industry may, and presumably will, face severe competition in the immediate future, there seems to be no inherent reason why, with efficient management, and proper forestry it cannot compete favorably in the long run with foreign industry not only in the production of pulpwood but also in quality and price of the manufactured product.

7. There are indications that the American pulp and paper industry, especially in the South and the Pacific Northwest, will probably greatly enlarge its plant capacity in the next decade or two, regardless of Government aid or encouragement. It would, therefore, seem to be wise public policy to develop at once a far-sighted program of forestry and land use to supply such additional pulpwood as this development would require, to prevent the further wrecking of our forests and to guide this expansion of industry.

FOREST CONSERVATION

8. Definite measures to enlarge domestic production of pulpwood, pulp, and paper would stimulate forest conservation in the broadest and most inclusive sense of the word and might also benefit agriculture.

9. Neither largely increased productivity of American forests nor a greatly enlarged pulp and paper industry can be developed over night. Both, and particularly the former, would require careful planning and years of effort for consummation.

10. Public forestry, of which pulpwood production is an integral part, undoubtedly offers one of the best opportunities for large-scale relief of unemployment over long periods of years and can be effectively combined with subsistence homesteading and other forms of stable community development.

RECOMMENDED POLICY

The many complications of international trade, agricultural adjustment and forestry, which are involved in the pulp and paper situation, need continuous study—but it is essential to formulate an objective for national planning on the basis of present knowledge.

Present pulpwood, pulp and paper imports enable foreign customers to purchase agricultural and industrial exports from the United States, and curtailment of these imports might tend to reduce exports and increase unemployment in exporting industries.

Nevertheless, in view of the facts that expansion in pulpwood, pulp and paper production, would offset in part, at least, the losses which agriculture and other industry might suffer;

That the United States might be found unprepared should the existing competitive situation in world pulp and paper markets be reversed;

That the public interest in the productive use of forest land should be protected by guiding along sound lines the probably inevitable expansion of the American pulp and paper industry;

That the fullest possible advantage should be taken of pulpwood production to advance the national forestry movement to which the administration and the country are committed;

That public forestry, which is likely to be an expanding and perhaps dominant element in the national forestry movement, and which will include pulpwood production, has proven one of the best available means for relieving both rural and urban unemployment; and

That the forestry program of which pulpwood production is an essential phase, can make a major contribution to land use, assist in the stabilization of communities and promote social and economic security;

The wise course for national policy seems to be:

To go ahead with a forestry program which would restore and maintain the productivity of the timber lands of the United States so as to place us in position to meet future requirements as may become necessary or desirable;

To give every public countenance and encouragement short of subsidy, tariffs, or other direct aid, to the development of the American pulp and paper industry; and

To place no obstacles in the way of the replacement of existing imports by the domestic industry in open competition.

PRESENT AND PROSPECTIVE PAPER, PULP, AND PULPWOOD REQUIREMENTS

Satisfaction of requirements for pulp and paper is a national problem the significance of which has been little realized by the American public. Almost every aspect of life today is inextricably influenced or facilitated by the use of paper. Since paper is primarily a forest product, the source of raw material for pulp and paper manufacture becomes an integral and essential part of the national problem of forest conservation. But because of long-established and increasing dependence upon imports, our pulp and paper supply is also an important factor in foreign trade.

In answer to the specific requests in the Senate Resolution this report deals primarily with the extent of dependency, the ability of the forests of the United States to supply national requirements for pulp and paper and the relation of this problem to forest conservation. Other economic considerations will, however, be given some attention in a supplementary chapter.

PAPER AND PULP REQUIREMENTS

The extent to which the United States now depends upon imports of pulpwood, wood pulp, and paper to meet the national requirements can be best visualized by an analysis of consumption statistics.

Paper consumption in the United States has, in general, shown a geometrical rate of increase for more than a hundred years, reaching a high mark of over 13 million tons in 1929. Since that time depression influences have caused some recession, but the present norm is between 10 and 12 million tons per annum. The course of annual consumption from 1899 to 1933 is shown, by principal paper grades, in table 1. There seems reasonable basis for the assumption that the saturation point has not yet been reached and that a still greater consumption may be anticipated.

TABLE 1.—*Paper: Consumption by kinds and per capita, specified years beginning 1810*¹

Year	News- print	Book	Boards	Wrap- ping	Fine	All other	All kinds	Per capita
	<i>M tons</i>	<i>M tons</i>	<i>M tons</i>	<i>M tons</i>	<i>M tons</i>	<i>M tons</i>	<i>M tons</i>	<i>Pounds</i>
1810.....							² 3	1
1839.....							² 38	4
1859.....							² 127	8
1879.....							457	18
1899.....	569	314	394	535	113	233	2, 158	57
1904.....	883	495	521	644	142	365	3, 050	74
1909.....	1, 159	689	883	763	193	537	4, 224	93
1914.....	1, 576	926	1, 292	892	244	566	5, 496	112
1919.....	1, 892	838	1, 940	825	306	692	6, 493	124
1922.....	2, 451	968	2, 154	1, 059	356	1, 015	8, 003	146
1925.....	3, 073	1, 365	3, 290	1, 287	472	1, 103	10, 590	184
1926.....	3, 517	1, 408	3, 637	1, 435	495	1, 315	11, 807	203
1927.....	3, 492	1, 265	3, 737	1, 515	502	1, 404	11, 915	202
1928.....	3, 561	1, 321	4, 009	1, 457	538	1, 562	12, 448	208
1929.....	3, 813	1, 471	4, 398	1, 586	593	1, 490	13, 351	220
1930.....	3, 496	1, 370	4, 014	1, 556	564	1, 251	12, 251	199
1931.....	3, 261	1, 195	3, 795	1, 383	430	1, 116	11, 230	181
1932.....	2, 831	935	3, 297	1, 234	418	885	9, 599	154
1933.....	2, 711	1, 069	4, 055	1, 425	472	1, 130	10, 862	173

¹ Imports added to United States; production and domestic exports deducted.

² Domestic production only, value of exports and imports being approximately equal.

WOOD MOST IMPORTANT RAW MATERIAL IN PAPER MANUFACTURE

Wood comprises about 85 percent of the primary fibrous raw material used for paper making. Rags, straw, bagasse, manila stock, esparto, and other fibers of miscellaneous origin make up the balance. Attempts are constantly being made to utilize for paper production various field plants and plant wastes, such as cornstalks, hemp, flax, ramie, bamboo, reeds, and grasses. Nearly all such fibers possess

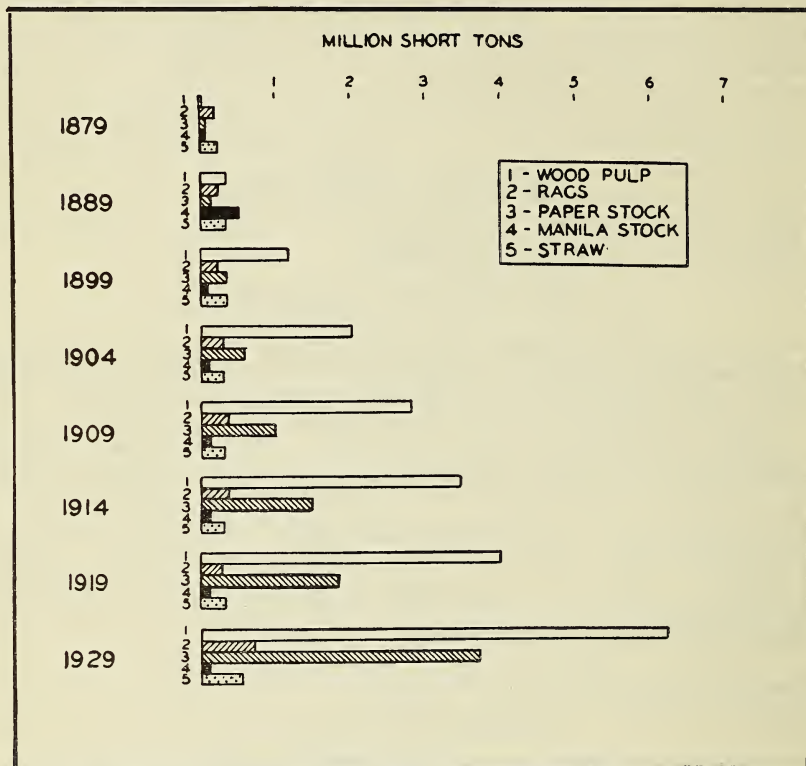


FIGURE 1.—Fibrous raw materials consumed in United States paper manufacture.

peculiar properties which fit them for limited use in special papers. None, however, can at present compete with wood in the production of large-tonnage paper grades. Wood, as an extremely compact form of cellulose fiber, is easily available, convenient to handle, presents fewer storage problems, and is cheaper than practically any other pulp raw material; it seems destined to be the principal source of paper for a long time to come.

The preponderance of wood used for pulp and paper manufacture is shown in figure 1, where wood pulp and paper stock, which is largely of wood, comprise 10.1 million tons of the 11.6 million tons total of all fibrous materials used in 1929.

DEPENDENCE ON IMPORTS FOR PAPER AND PULP REQUIREMENTS

American dependence upon foreign sources for finished paper is limited mainly to newsprint, which comprises more than 95 percent of all paper imports. Annual imports of newsprint of almost 2 million

tons are now about twice as large as the amount manufactured in the United States from raw materials of whatever origin. Other grades are imported in minor quantities, and such imports are largely offset by exports of similar grades. The relation of production, imports, and exports to consumption of major paper grades for the year 1930 is shown in figure 2 which reflects fairly closely conditions now existing. It does not tell the whole story of the import situation, however, since domestic production of paper at present relies upon outside sources for considerable quantities of both wood pulp and pulpwood. Of the wood pulp used, about 30 percent is imported, and of the 70 percent manufactured in this country some 20 percent is made from imported pulpwood—chiefly spruce with smaller quantities of balsam fir, and aspen. Thus approximately 44 percent of our domestic pulp use is based on foreign pulpwood, and of our entire pulp and paper requirements more than 50 percent has for some years been imported in the form of either paper, pulp, or raw pulpwood.

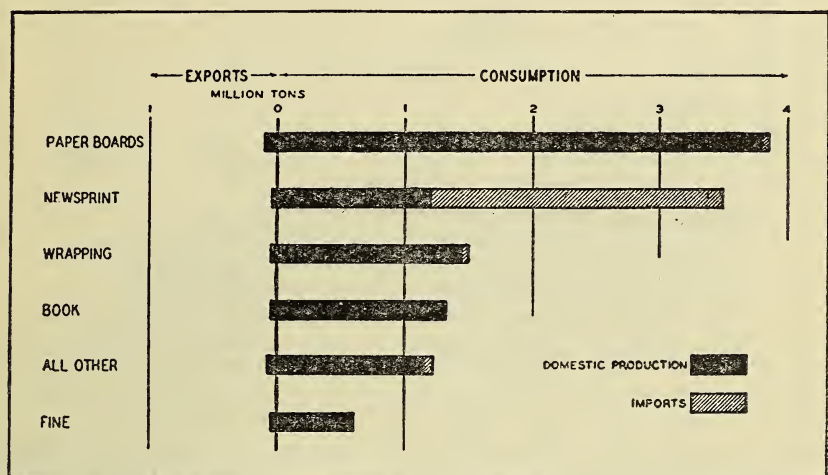


FIGURE 2.—United States consumption, imports, and exports of principal paper grades in 1930. (Source: "The Pulp and Paper Industry", by C. W. Boyce and W. G. MacNaughton, Prentice-Hall, Inc., New York N. Y., 1932. Used by permission.)

Probably a better conception of the quantities involved can be gained by converting all imports and all domestic pulpwood, pulp, and paper consumption into cords of pulpwood. The resulting figures for several recent years are shown in table 2.

TABLE 2.—Origin of pulp and paper consumption of the United States in terms of pulpwood

[Thousands of cords]

	1923	1926	1929	1932	1933
Paper imports.....	1,827	2,485	3,174	2,278	2,288
Woodpulp imports.....	2,413	3,090	3,377	2,270	3,451
Pulpwood imports.....	1,236	1,277	1,249	742	724
Total imports.....	5,476	6,852	7,800	5,290	6,462
Domestic pulpwood consumption.....	4,637	5,489	6,397	4,890	5,838
Total pulpwood requirements.....	10,113	12,341	14,197	10,180	12,301
Percentage of total requirements from foreign sources.....	54	56	55	52	53

Imports of paper, almost entirely newsprint, come principally from Canada. The same is true of imported pulpwood. Canada also is the source of about 85 percent of imported mechanical pulp and more

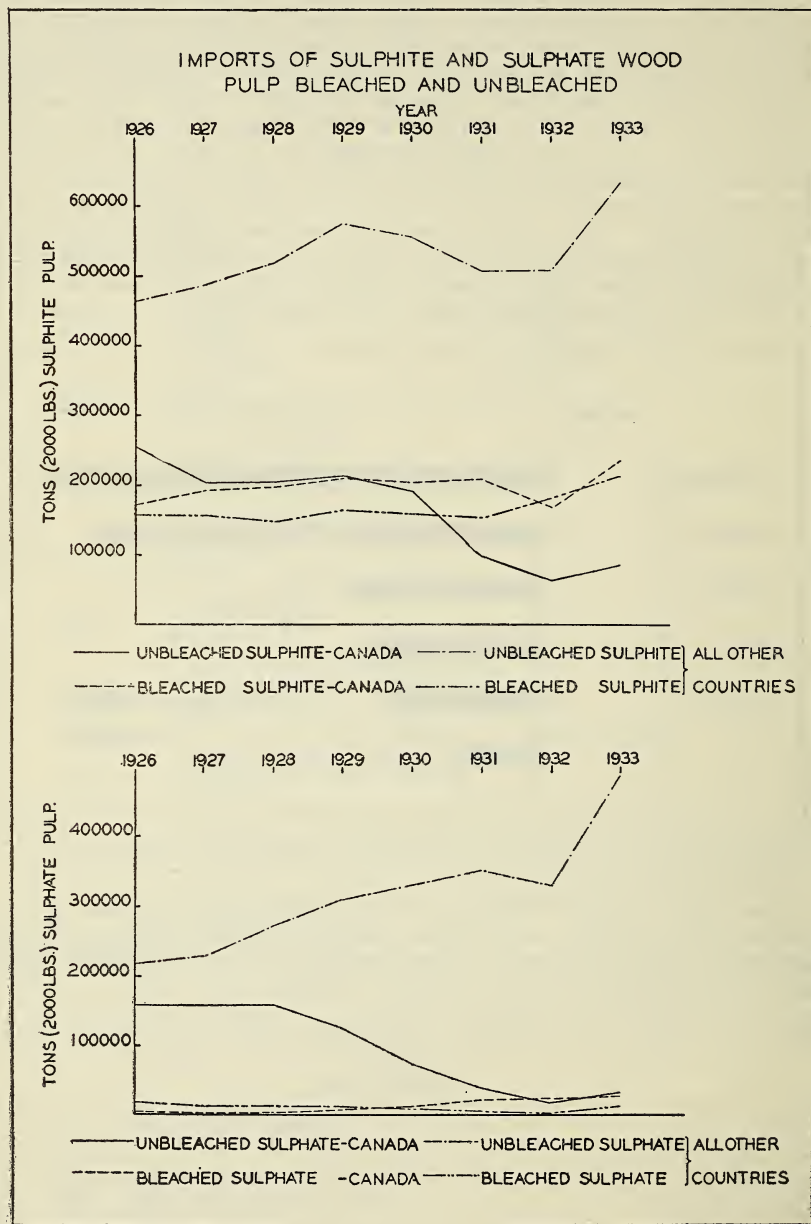


FIGURE 3.—United States imports of sulphite and sulphate wood pulp.

than half of the imported bleached sulphite. Of unbleached sulphite and sulphate pulps, the greater proportion now originates in Sweden, Norway, and Finland, the trend toward European sources having

been marked since 1929. Import trends in all of the latter pulps are shown in figure 3.

Foreign sources have always been utilized in supplying some part of domestic paper needs, but major dependence is of comparatively recent origin, as shown in figure 4. At the beginning of the present century 83 percent of our pulpwood needs was supplied domestically. Subsequently an increasing reliance on foreign supplies developed, being met first by increasing imports of pulpwood, which were supplemented later by shipments of wood pulp and finally by large consignments of newsprint paper. A low point for the home industry was reached about 1928, when only about 43 percent of domestic paper was made from domestic wood. Since then there is an indication of a

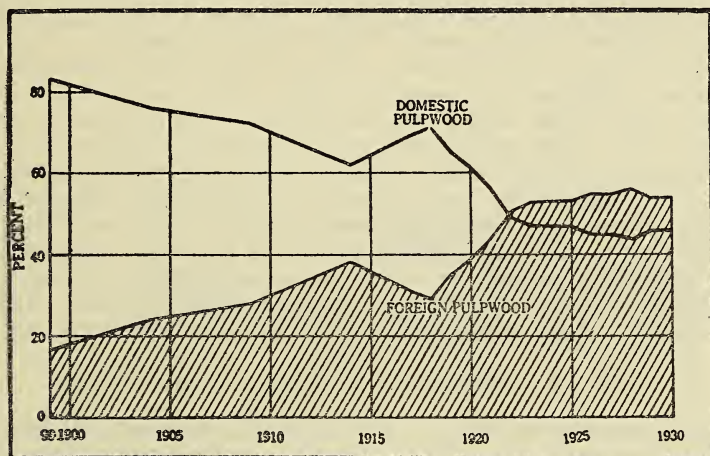


FIGURE 4.—Domestic and foreign pulpwood entering into United States paper consumption, in percentages, 1899-1930. (Source: "Pulpwood", American Paper and Pulp Association, October 1931.)

slight upward trend, probably as a result of the growth of the southern sulphate and the western sulphate and sulphite pulp industries.

PULPWOOD REQUIREMENTS

Wood pulp is classified according to its process of manufacture as mechanical (groundwood) sulphite, sulphate, and soda. Imports of pulp are confined almost entirely to products of the first three processes.

Mechanical pulp is produced by simply grinding wood on a stone, thus reducing it to fiber with practically no chemical change. The three other processes depend upon chemical action of various reagents, which dissolve the nonfibrous components of the wood and leave a fibrous residue. In all chemical processes the wood is reduced to chips and cooked in pressure vessels at a relatively high temperature. In the sulphite process an acid liquor composed of sulphurous acid and bisulphite of lime is used. In making soda pulp an alkali liquor composed mainly of caustic soda is employed. The sulphate process utilizes a solution of caustic soda and sodium sulphide, the latter being derived from sodium sulphate, from which the process gets its name. Recently several new processes have been developed in an effort to increase yields or to substitute little-used wood species for heavily

used species, the supply of which is diminishing. Certain of these new processes will be described later.

The mechanical process, although simple and economical, is very exacting in wood requirements. Few species can be successfully and economically ground to produce a product of desired quality. Spruce is the most desirable wood, with balsam fir, other true firs, and western hemlock ranking next in order. Up to the present, spruce has been the mainstay of the mechanical process, while the firs and hemlocks have attained some prominence in recent years. The result has been a greater demand and a higher price for all these species, largely offsetting the cheapness of the process itself.

Sulphite pulp has more varied uses than any other kind of pulp. Since this process does not eliminate resins and pitch, only woods of low resin content are suitable for it. Spruce, fir, and hemlock have been the woods chiefly used. The sulphite process is much more expensive than the mechanical because of the labor, chemicals, and equipment necessary to cook the wood, and the yield per cord of wood is only about half of that obtained in the mechanical process.

The soda process, which is adapted to many kinds of wood, has had its chief use with short-fibered hardwoods such as the poplars, gum, etc. The sulphate or kraft process is particularly adapted to the pulping of resinous and pitchy woods, such as the southern pines. It is the most universally applicable of all processes, and its use has been expanding rapidly in recent years, not only in volume of production, but also in the variety of uses to which it is put. The yield per cord of wood is about the same as in the sulphite process.

USE OF WOOD PULP IN VARIOUS PAPER GRADES

Although about 85 percent of all paper is now produced from wood pulp, the amount of new, i. e., freshly prepared, wood pulp that is used averages only from 50 to 60 percent of the total composition or "furnish" of all papers and boards. The remainder consists of repulped old papers (mainly derived from wood pulp), rags, straw, and miscellaneous fibers. The distribution of freshly made wood pulp in various paper grades is shown in table 3. These figures are, of course, only roughly accurate. It will be noted that new fiber used ranges from 104 percent for newsprint down to as little as 22 percent in boards.

TABLE 3.—*Proportion of new wood pulp used in the manufacture of various grades of paper, in percent of paper weight*¹

Grade of paper	Class of pulp				Total new wood pulp
	Mechanical	Sulphite	Soda	Sulphate	
	(1)	(1)	(3)	(4)	(5)
	Percent	Percent	Percent	Percent	Percent
Newsprint.....	78.5	25.8			104.3
Book.....	6.0	25.1	24.4		55.5
Boards.....	3.9	9.1		9.2	22.2
Wrapping.....	11.0	35.1		53.4	99.5
Fine.....		59.5	6.1	1.5	67.1
All other.....	20.5	30.6	7.5	4.8	63.4
All paper.....	16.7	22.9	4.7	12.2	56.5

¹ These percentages are not the pulp content of the paper, as they include also losses of fiber in manufacture.

Standard newsprint paper is made from spruce, fir, or hemlock sulphite with groundwood from the same species. Bonds and writing papers, where of wood pulp origin, are made largely of bleached sulphite pulps. Book papers of the better grades are combinations of bleached soda and sulphite stock plus certain quantities of repulped old magazine or book papers made from 100 percent chemical wood pulp. The cheap book grades carry varying percentages of spruce or fir groundwood, often bleached by reducing agents such as sodium bisulphite.

Wrappings are from either bleached or unbleached sulphate or sulphite pulps, or, in the case of special grades, from manila stock. Boards are produced from a wide variety of stock, including repulped old news and mixed waste papers, straw, bagasse, cornstalks, licorice

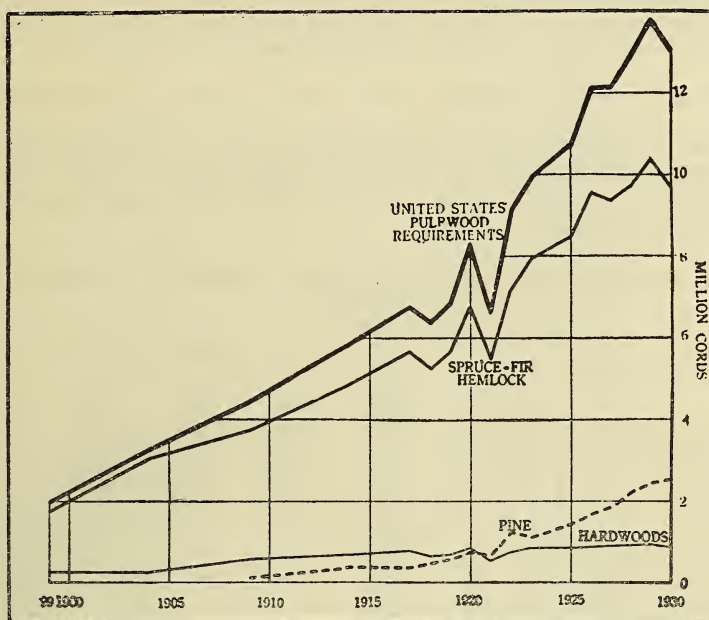


FIGURE 5.—United States pulpwood requirements by types of wood 1899-1930. (Source: "Pulpwood", American Paper and Pulp Association, October 1931.)

root, extracted chestnut chips, etc., with varying proportions of kraft and also of sulphite, groundwood, and jute stock. Other papers, such as tissues, glassine, wood bristols, etc., carry varying proportions of bleached sulphite, high grade bleached groundwood, and a number of special fibers.

Using the best available conversion factors for converting tons of paper products to cords of wood, and making the purely arbitrary assumptions that only spruce, fir, and hemlock are used in groundwood and sulphite pulps, only pines in sulphate, and only hardwoods in soda pulp, we get a rough approximation of present dependence upon the principal groups of species and the trends in their use, as shown in figure 5. It will be noted that the spruce, fir, and hemlock group accounted for about 10 million of a total requirement of 13 or 14 million cords a year. In this group spruce is by far the most important item.

IMPORTANCE OF SPRUCE AS PULPWOOD

The primary cause of the Nation's dependence on foreign sources of supply is the reliance of the industry upon spruce pulpwood. Spruce is so peculiarly suitable for pulping, particularly for major tonnages of sulphite and groundwood pulps and newsprint paper, that industry has tended to locate where spruce could be obtained. The relatively pure stands of spruce in the Northeast, fortunately near the large markets and adjacent to cheap water power, influenced early establishment of mills there. As the wood supply diminished, increasing use was made of wood imported across the nearby Canadian line. Stimulated by the removal of the American tariff on newsprint paper and pulp in 1913 and by the threat of a Canadian embargo on pulpwood, a transfer of some mills and a large development of new production, principally newsprint, in eastern Canada has been predicated largely on cheap and plentiful supplies of spruce pulpwood and of low cost power.

SPRUCE HOLDS PLACE DESPITE INCREASING USE OF OTHER PULPWOODS

In the meantime research developments have not been lacking to stimulate a broadening of species use within the country. This is illustrated by the increased use of other pulpwoods than spruce that is recorded in table 4.

TABLE 4.—*Relative importance of principal species in pulpwood consumption of the United States*¹

	1899	1909	1919	1929	1933
	<i>Cords</i>	<i>Cords</i>	<i>Cords</i>	<i>Cords</i>	<i>Cords</i>
Spruce.....	1,509,202	2,421,581	3,187,214	3,104,180	2,071,061
Hemlock.....		559,657	795,154	1,324,549	1,112,556
Southern yellow pine.....		90,885	234,463	1,036,272	1,560,414
Poplar (aspen).....	256,953	328,498	338,380	487,295	333,438
Balsam fir.....		95,366	288,814	362,964	302,931
White fir.....		37,176	31,138	111,054	154,847
Jack pine.....		(a)	51,581	195,577	173,974
Other species.....	4 220,155	219,467	376,007	461,835	367,312
Mill waste.....		248,977	175,031	561,285	480,141
Total.....	1,985,310	4,001,607	5,477,832	7,645,011	6,561,674

¹ Includes both domestic and imported pulpwood.² In addition to amounts separately reported some balsam fir is included in figures for spruce.³ Included with southern yellow pine.⁴ Includes species listed for which no figures are given for this year.

Wherever it occurs, balsam fir is now mixed indiscriminately with spruce in all processes. The true firs of the Pacific Northwest have like aptitude and have come into appreciable use in that region. The use of hemlock in the Lake States is extensive in sulphite pulps, both in the news and wrapping grades, while western hemlock in the Pacific Northwest is utilized for mechanical and sulphite pulps (largely bleached sulphite) with a considerable use also in newsprint production. To this extent the hemlocks serve to relieve dependence on Canadian or other outside sources of pulp, but not to a degree equal to the increase in consumption of the products involved.

Hardwoods have found limited but increasing use in the sulphite and groundwood processes for specialty papers, and they are the mainstay of soda pulping. Southern yellow pines have come into

rapidly increasing use since the introduction of the sulphate pulp industry in 1908. Miscellaneous species, such as jack pine and tamarack, have infiltrated gradually—principally in sulphate pulping but also in other processes—as existing mills, faced by shortage of favored pulpwood species and encouraged by research progress, found it expedient to use them to replace spruce or balsam fir.

But despite the use of new woods, the relative amount of spruce consumed in meeting domestic needs has not greatly decreased. This

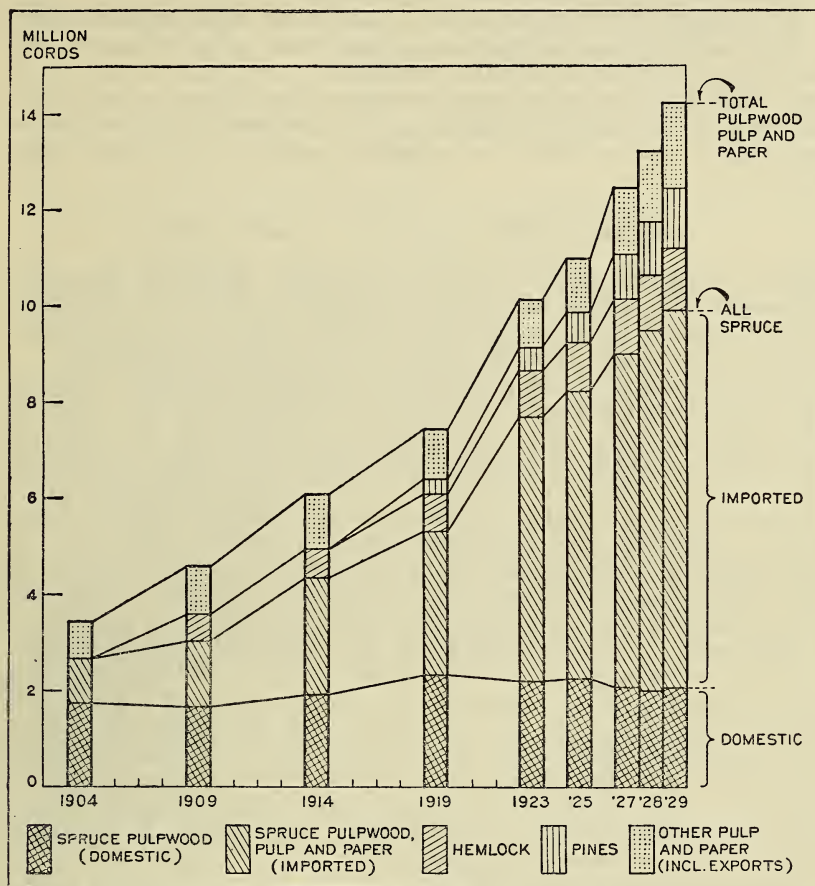


FIGURE 6.—Increasing imports maintain relative importance of spruce in United States pulpwood requirements.

statement holds regardless of the fact that domestic spruce pulpwood, while varying but little in actual number of cords consumed, declined from 52 percent of the total pulpwood requirement in 1904 to 14 percent in 1929. But adding imports of spruce pulpwood and assuming imports of pulp and paper to represent also requirements for spruce, which is more or less the case, then spruce supplied approximately 80 percent of our wood requirements in 1904, dropped to 70 percent in 1919, and has subsequently remained essentially on that level. (See fig. 6.)

POSSIBILITIES OF BROADER SPECIES USE

The increasing use of other species than spruce, as described in the preceding paragraphs, is capable of being carried much further. There are possibilities of development in at least three directions, in all of which progress is evident and will probably continue simultaneously. These are:

(1) A wider adaptation of the sulphite or groundwood processes to species other than spruce, fir, and hemlock.

(2) Substitution of pine and Douglas fir, or other sulphate pulps for spruce-fir-hemlock sulphite and groundwood pulps in papers now made principally from the latter products

(3) The development of new processes especially adapted to the reduction of the pines, Douglas fir, and hardwoods, or to other species now unused or used only to a limited extent in pulp and paper reduction.

NEWSPRINT FROM SOUTHERN YELLOW PINES

Since newsprint paper not only constitutes the most important element in the problem of pulpwood supply but also has been almost entirely dependent upon spruce-fir-hemlock pulps, the possibility of using other species for this purpose is of especial significance.

In the potential development of a domestic newsprint industry adequate to meet domestic consumption, current interest centers on the southern pines. The vast area of forest land in the southern pine region, as will be shown in a later section, is capable of supplying tremendous quantities of pulpwood and is relatively accessible to the principal consuming markets of the country. Rapid growth and easy logging conditions put production on a favorable basis but the extremely low prices for wood which prevail at present may not be expected to obtain over long periods under actual working conditions.

The South is also favorably situated with respect to supplies of sulphur and limestone needed in the chemical pulp processes. Although water power is not so generally available in the South as in the Northeast and in Canada, nevertheless many developed and potential power sources, as in Alabama and the Tennessee Valley, are at hand, and cheap steam power may offset any deficiencies in this connection. On the other hand development of the newsprint industry in the southern pine region may perhaps be limited by economic considerations, such as current overcapacity of newsprint mills in North America as a whole.

Many proposals made in the past to utilize southern pines as raw material for newsprint have been dismissed by objections that the color, resin content, and coarse fiber characteristics of the pines will effectively prevent their use for that purpose. However, as recently pointed out by Dr. C. H. Herty, director of the pulp and paper laboratory of the Industrial Committee of Savannah, Ga., young second-growth southern pines are of excellent color, low in resin, and relatively free from the heartwood that has heretofore been an outstanding obstacle to their reduction by the sulphite and mechanical processes. These processes have been applied to such wood on a laboratory basis, both at Savannah by Dr. Herty and at the Forest Products Laboratory, in the production of newsprint which closely

approximates so-called "standard" newsprint in quality. Furthermore, Dr. Herty has conducted a mill test run in which practically none of the predicted difficulties developed, and cost estimates made by qualified engineers indicate favorable economic possibilities.

It would appear that the technical objections to the southern pine newsprint proposal, have been tinged with the same conservatism which formerly deprecated the use of southern pine for kraft and of western hemlock for sulphite and newsprint. Improvement of the quality of experimental yellow pine newsprint, already very close to that of the standard commercial product, will almost certainly result under manufacturing development. Production difficulties are of course no less inevitable, but there is no lack of technical ability to meet them. Possible difficulty in the selection of wood before use to obtain large quantities of practically heart-free wood may be largely eliminated by proper integration with the lumber industry in the matter of raw material supply.

Susceptibility of southern yellow pine sapwood to blue stain also presents a problem the best handling of which will require further study. Experiments have definitely proved that a moderate amount of blue stain is not harmful, but on the contrary actually improves the color of groundwood pulp by masking the characteristic yellow tint. Sulphite pulps made from blue-stained wood are definitely darker and dirtier than those from unstained material, but here again if the amount of stain is not excessive the utility of the pulp for newsprint is not seriously affected. However, large quantities of blue stain carry through in both the mechanical and sulphite processes and would unquestionably destroy the value of such pulps for newsprint.

Blue stain can probably be most effectively controlled by close correlation between woods and pulping operations so that wood will be used within a short time after it is cut, probably not more than a few weeks. A similar condition has always confronted southern pulp mills where the rapid action of wood destroying fungi has had to be met and the problem has been successfully solved in practically all existing mills.

Moreover, many observers feel that the most promising outlook for southern pine newsprint lies not in the sulphite pulping process at all, but rather in a combination of sulphate pine pulp with the pine groundwood. Such a procedure would limit the necessity of wood selection to only one process (the mechanical), since the alkaline kraft process will reduce heartwood, highly resinous material, or cull pine of any character. Experiments at the Forest Products Laboratory on such a project have resulted in the production of entirely satisfactory newsprint papers from pine groundwood combined with semibleached and also unbleached pine sulphate pulps, with cost estimates well down to the level of standard newsprint costs.

PROSPECTS OF WIDER USE OF HARDWOODS

There is the further possibility of developing a newsprint industry based on hardwood utilization. Experiments carried on at the Forest Products Laboratory in 1926-27 resulted in the production of newsprint papers containing some 60 percent hardwood pulp (both sulphite and groundwood), at an estimated cost comparing favorably

with the then quoted costs of newsprint paper. The quality of these papers was equal to that of standard newsprint in all respects save opacity.

Recently (August 1934) certain Tasmanian interests completed mill-scale tests in western Canada in which, according to press reports, several hundred tons of newsprint paper of satisfactory quality were produced through the use of hardwood (eucalyptus) sulphite and groundwood pulps.

Conceding that the cost of producing hardwood newsprint is greater than present standard newsprint costs, any large increase in the cost of spruce-fir-hemlock pulpwoods, such as might develop if southern pine production does not assume large proportions, would be a strong incentive to the use of hardwoods in the newsprint of the future.

The same conditions that hold for newsprint apply with equal force to the entire group of mechanical and sulphite pulps, regardless of use. Any development which broadens the utility of pines or hardwoods for newsprint, by the same token increases their usefulness in other grades. Whether or not the pines enter these fields commercially, progress in the technique of pulping hardwoods by the sulphite and groundwood processes has already extended the use of these species markedly. Between 1926 and 1930, use of hardwoods in the two processes rose from 28,000 cords to more than 100,000 cords per annum, with no perceptible diminution of hardwood use in the soda process.

BLEACHED SULPHATE POSSIBILITIES

Apart from other developments, significant progress has been made toward successful bleaching of southern pine sulphate pulp. Simple modifications in cooking and the development of effective multiple-stage chlorination bleaching has brought the sulphate pulps to the threshold of all-purpose use. Recent entry of the sulphite wrapping field by semibleached and full bleached southern pine kraft pulps has been very successful. The obvious trend is to release any sulphite tonnage so displaced to other grades. A somewhat similar utilization is probably practicable with Douglas fir and a number of northern and western conifers that are now used for kraft but are not in the preferred class for sulphite or groundwood production.

SODA BASE SULPHITE PULPING

Again, the broadening of species use in the sulphite process along other lines is by no means improbable. Besides the adaptation of the standard sulphite process to heart-free southern pines, previously mentioned, the substitution of a soda base for the usual lime base of the sulphite process apparently offers advantages in the reduction for many resinous species. If the soda-base sulphite process is successfully used, it will necessarily involve the recovery of chemicals, which is not at present feasible in the standard sulphite process. This feature will be of immense benefit in the abatement of stream pollution by waste sulphite liquors. The increasing public interest in the elimination of stream pollution has put new emphasis on the problem of disposal of waste liquors from the conventional sulphite process

particularly in the more densely populated areas. For this one reason, if for no other, the further development of soda-base sulphite pulping is of particular significance at the present time.

DEINKING OF OLD NEWSPAPERS

Reuse of old newspapers in newsprint has frequently been suggested as a rational measure of economy, but it has never proved a practical success. It remains a latent source of newsprint, however, and the work of S. D. Wells in this field is of interest. Wells' process depends in the first place upon the use of printing inks which can be bleached by the action of sulphur dioxide. It is now being applied to the recovery of pulp from telephone books and catalogs printed in quantity with these special inks. A next logical step is to enlist all the newspaper publishers in a given metropolitan area in the use of the bleachable inks, and to obtain coordination of collecting agencies so that the papers can be deinked and reconverted into newsprint, thus reducing the amount of raw pulp required in a given unit of production to about one-third of the normal consumption.

It is undoubtedly true that diversion of such quantities of old newsprint would seriously disturb the present pulpboard industry, which depends on this source for much of its raw material. On the other hand, boards generally are more susceptible to changes in the character of "furnish" than any other paper grade, and the possibility of using the cheaper woods and cheaper pulping processes for boards is much greater than in other paper products.

MODIFIED PULPING PROCESSES

The neutral sulphite and the various semichemical processes have assumed positions of considerable importance in pulp manufacture in recent years. The former consists of delignification by means of a neutral solution of sodium sulphite, in contrast to the strongly acid or alkaline cooking liquors used in processes previously described. In the semichemical processes, a mild chemical treatment is given with any of the several standard cooking liquors to soften the chips, followed by their mechanical reduction to pulp condition. The advantage lies mainly in the increased yield obtained from a given quantity of wood. These processes are particularly promising in the utilization of second-growth hardwoods, and a rather extensive use has been made of semichemical pulping in the production of corrugating board from extracted chestnut chips.

Recent research points to more effective use of sulphite and suphate cooking liquors through closer control of chemical concentrations and the use of higher cooking pressures. Particularly good results have followed the use of lower concentrations of sulphate chemical in obtaining light colored and easier bleaching kraft pulps from pine, which hold possibilities of direct competition with unbleached sulphite pulps. An interesting adjunct to this work is the development of continuous digesting equipment which promises lower cost of operation, especially of the alkaline and neutral processes.

Experimental researches on the use of microorganisms having selective action on wood components are in progress. These, or the development of cheap organic reagents, may hold the key to entirely

new departures in pulp manufacture. Methods of bleaching have recently undergone immense improvement, and the processes of beating and strength development in all grades of pulps, as well as means of making the most of fiber properties in conversion to paper, are under careful scrutiny by competent research staffs throughout the world.

The total effect of all the experiments and new developments that have been described will inevitably be to broaden pulp resources and to aid their successful use. Any progress of the United States toward independence in pulpwood supply must be accompanied by unflagging efforts to advance commercial pulping technique along some or many of these lines.

TRENDS OF PAPER CONSUMPTION

The consistent increase in consumption of paper products for more than 100 years has already been mentioned. Consideration of the

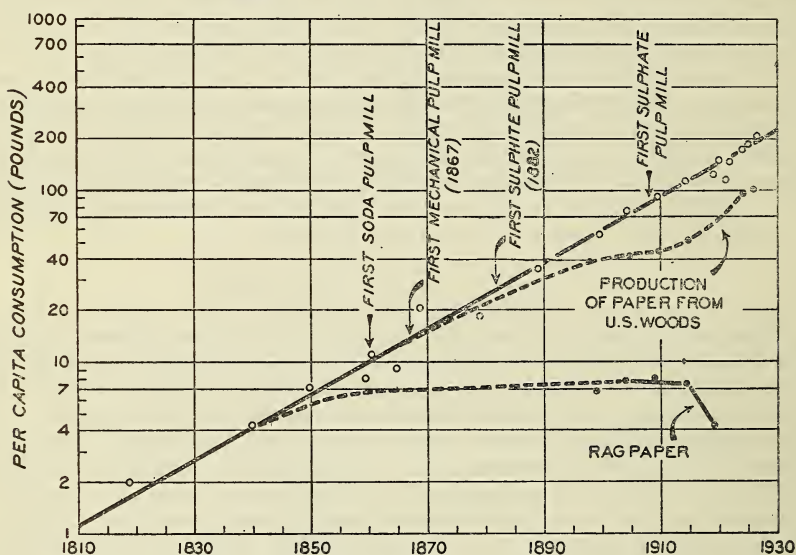


FIGURE 7.—Per capita consumption of paper and boards in the United States 1810-1930.

current consumption trends is of obvious importance in estimating future pulpwood needs. If the rates of increase which have obtained in the past, as indicated in table 1, were to continue indefinitely, staggering totals would result in a comparatively few years. Practically all observers believe, however, that a slowing up of the rate of increase is inevitable, despite the fact that per capita consumption in the United States has maintained a uniform rate of increase for over 100 years, as shown in figure 7.

Excellent summaries of probable consumption trends have recently appeared in a survey by C. W. Boyce in the American Paper and Pulp Association publication *Pulpwood* for October 1931, and in Forest Service estimates published in *A National Plan for American Forestry*, Senate Document No. 12, Seventy-third Congress, first session, hereinafter referred to as the "Copeland Report." Conclusions from the two studies are in general agreement. By analysis of

data on trends of population and of the total and per capita consumption of the six general classes of paper (i. e., newsprint, book, fine, wrapping, boards, and all other) and by the use of certain assumptions as to probable utilization, an estimated requirement between 24 and 30 million tons per annum is set up which, if the indicated rate trends were maintained, would be reached within the next two or three decades.

Boyce, in his discussion, considers each grade separately and develops the use picture shown in figure 8. The curves below the

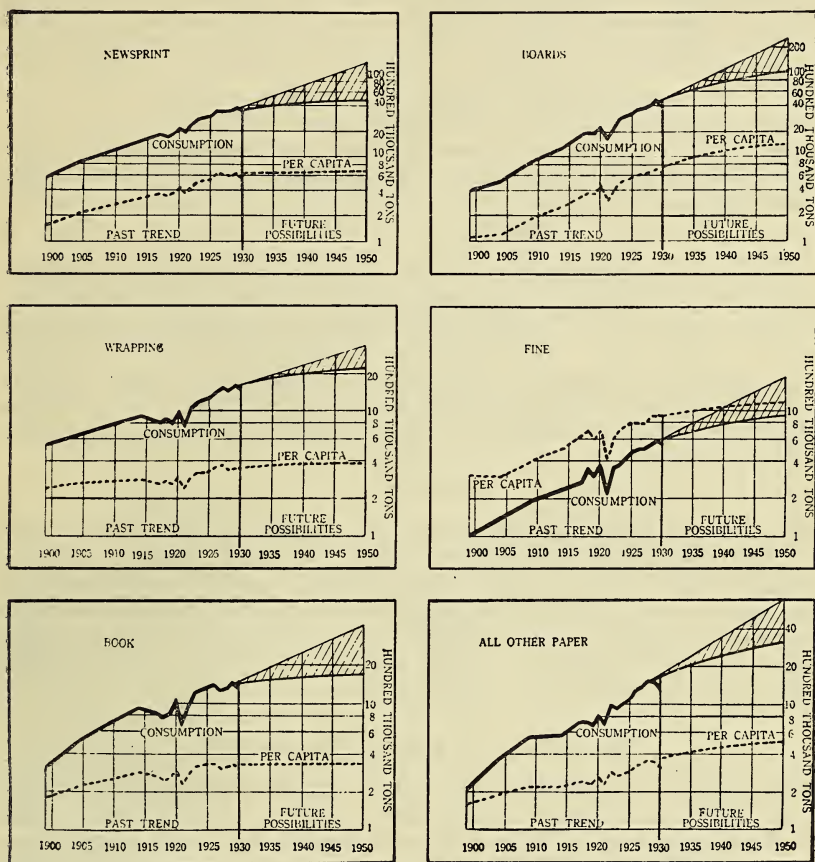


FIGURE 8.—Past and possible future trends of paper consumption in the United States by kinds of paper 1899-1950. (Source: "Pulpwood", American Paper and Pulp Association, October, 1931.) For per capita consumption the scale at the right should be read in tens of pounds.

shaded areas in figure 8, which are plotted on a logarithmic vertical scale, show the consumption trends predicted as most likely. The upper curves show potential requirements should the trend of increase from 1899 to 1928 continue without interruption, an extremely improbable eventuality. Recent indications of trend changes may not as yet have sufficient background to be significant, and it is difficult to evaluate depression influences, but the altered trends are certainly more nearly in line with current ideas, as reflected in the industry,

and are not too conservative for basing of pulpwood requirement estimates.

The following is an abstract of Boyce's analysis by grades. He points out that population is tending to become stabilized and that while paper consumption as a whole has not yet reached saturation, in many paper grades there is apparent evidence of an approach to that point.

NEWSPRINT

In newsprint, for example, there has been a decline in the size of Sunday editions, and daily editions have tended toward a level of about 30 pages. Advertising, which vitally affects newspaper size, is assumed to have reached a peak, and circulation increases are leveling off. Making due allowance for these and other indicated changes, it is concluded that future rise in per capita consumption of newsprint will be at a gradual rate, if at all. Balancing all factors, the prospective annual requirement is placed at slightly more than 5 million tons.

BOOK AND FINE PAPERS

With book papers there is even more evidence of a condition approaching saturation in per capita consumption, and conservative estimates seem not to justify a prediction of more than 1¼ million tons by about 1950. The fine-paper classification, the other grade in the so-called "cultural paper class", holds out a more hopeful prospect, but the total use of this grade is moderate. An estimate of slightly less than 1 million tons per annum by 1950 seems justified by current trends.

BOARDS

Of the mechanical papers, boards bulk as the largest use by far and the most active possibility. Both container boards, used in packaging, and the so-called "fiber boards," used for construction purposes, are still increasing in use and do not appear to have reached a saturation level. A use in 1950 of more than double that of 1930 is deemed not unreasonable, and a tentative figure of about 11 million tons per annum by that time is set up.

WRAPPING AND ALL OTHER GRADES

The trend of wrapping paper use is less pronounced but is consistent and should carry consumption above 2 million tons in the next 20-year period. The "all other" group includes, in addition to tissue, absorbent, and hanging papers, the large group of specialty papers of all kinds for which there is an evidently increasing demand, with a sharp rise in recent years. Following the present indicated trends, this group should reach a per capita consumption of 40 or 50 pounds by 1950, accounting for an annual use by that time of over 3 million tons.

RAYON AND CELLULOSE FILMS

In addition to requirements for papers, there are prospects of increased production of rayon, du Pont Cellophane, and similar

films, and chemical cellulose derivatives, all of which call for an increasing use of wood pulp. Based on fragmentary data it was estimated in the Copeland report that approximately 100,000 tons of sulphite (roughly 200,000 cords of pulpwood) were consumed in the manufacture of rayon and cellulose film in 1931. The increase at present is so exceedingly rapid and the ultimate source of raw material so indefinite that prophecy as to eventual requirements seems fruitless. The use of cellulose products for plastics appears also to hold large potentialities for new development. Assuming that wood remains the cheapest and becomes the most suitable source of this type of product, the course of two or three decades may well witness the rise of wood plastics to a sizable factor in future requirements.

POSSIBLE FUTURE PULFWOOD REQUIREMENTS

The Nation's possible future requirement for pulpwood has been estimated in the Copeland report, without any specific limitation as to time, at 25 million cords per year. This seems a reasonable basis for national planning in the light of the foregoing review of Boyce's forecast of paper consumption for 1950, which, when converted into equivalent pulpwood requirements as shown in table 5, gives a figure in excess of 20 million cords, not including possible requirements for rayon and other chemical cellulose utilization.

TABLE 5.—*Pulpwood equivalent by classes of pulp of possible paper requirements in 1950 according to Boyce's estimates*¹

Kind of paper	Tonnage (1)	Pulpwood equivalent, thousand cords				
		Me- chanical (2)	Sul- phite (3)	Sul- phate (4)	Soda (5)	Total (6)
Newsprint.....	5,080,000	3,985	2,620	-----	-----	6,605
Book.....	1,750,000	105	880	-----	768	1,753
Boards.....	10,990,000	429	2,000	1,820	-----	4,249
Wrapping.....	2,120,000	234	1,490	2,030	-----	3,754
Fine.....	910,000	-----	1,084	25	100	1,209
All other.....	3,030,000	622	1,854	262	410	3,148
Total.....	23,880,000	5,375	9,928	4,137	1,278	20,718

¹ From trend analysis by C. W. Boyce, *Pulpwood*, October 1931. Paper tonnage allocated to classes of pulp according to table 3. Factors used in converting tons of pulp to cords of pulpwood: Mechanical pulp, 1 ton equals 1 cord; sulphite pulp, 1 ton equals 2 cords; sulphate and soda pulp, 1 ton equals 1.8 cords.

In table 6 the possible future requirement of 25 million cords is distributed among the various pulp processes in the same proportions as the pulpwood equivalent of prospective paper consumption shown in table 5. It appears that the total domestic production of pulpwood, which was only 45 percent of consumption equivalent in 1929, would have to be increased to almost four times its present volume if it were to meet these assumed future requirements. By far the greatest increases would be required in mechanical and sulphite pulps, or substitutes for these pulps, a development which is foreshadowed in the next section.

TABLE 6.—Possible future pulpwood requirements in relation to consumption and domestic production in 1929, by classes of pulp

	Possible future require- ments	Pulp- wood equiva- lent of 1929 con- sumption	Domestic pulp- wood produc- tion 1929	Increase of pro- duction to meet possible future require- ment
	(1)	(2)	(3)	(4)
Mechanical.....	<i>M cords</i> 6,500	<i>M cords</i> 3,651	<i>M cords</i> 1,224	431
Sulphite.....	12,000	7,024	2,693	346
Sulphate.....	5,000	2,549	1,685	197
Soda and other.....	1,500	973	793	89
All processes.....	25,000	14,197	6,395	291

POTENTIAL ABILITY OF FORESTS OF THE UNITED STATES TO MEET PULPWOOD REQUIREMENTS

As previously noted, as a basis for national planning possible future pulpwood requirements have been estimated at 25 million cords annually, distributed among the several classes of pulp as indicated

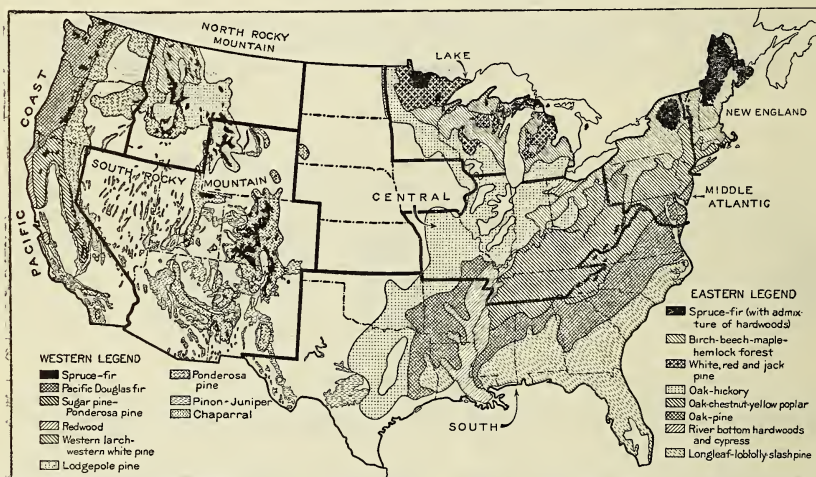


FIGURE 9.—Forest regions and principal types of forest. (Based on forest cover map "Forests of the United States", by Zon and Shantz.)

in table 6. To obtain a realistic picture of how these requirements might be supplied from the forests of the United States, the resource situation in each of the principal forest regions of the United States (as shown in fig. 9) and of Alaska is analyzed in succeeding sections in relation to present and possible future distribution of paper and pulp mills. From this analysis a possible distribution of prospective pulp production among the various forest regions has been worked out and is shown in table 7.

This suggested distribution should not be interpreted in any sense as a forecast or prediction. It simply serves to illustrate the balance

which might obtain between the forests of the various regions should prospective national pulp and paper requirements be supplied without dependence on imports. It has been prepared solely from the viewpoint of forestry and conservation as requested in the Senate resolution without considering the economic complications arising from possible shifts in international trade.

TABLE 7.—*Possible contribution of forest regions to prospective pulpwood requirements by processes of pulp manufacture*

[Thousand cords]

Region	Total	For mechanical and sulphite processes				For sul- phate process	For soda and semi- chem- ical proc- esses
		Total	For news- print paper	For other uses			
				Soft- wood	Hard- wood		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
New England.....	3, 250	2, 600	1, 000	400	1, 200	150	500
Middle Atlantic.....	1, 500	1, 200	200	200	800	50	250
Lake.....	3, 200	2, 200	400	800	1, 000	600	400
Central.....	500	500	-----	-----	500	-----	-----
South.....	7, 500	4, 000	2, 000	1, 000	1, 000	3, 200	300
Pacific coast.....	7, 050	6, 000	2, 000	4, 000	-----	1, 000	50
North Rocky Mountain.....	250	250	150	100	-----	-----	-----
South Rocky Mountain.....	250	250	100	150	-----	-----	-----
Alaska.....	1, 500	1, 500	750	750	-----	-----	-----
Total.....	25, 000	18, 500	6, 600	7, 400	4, 500	5, 000	1, 500

In allocating the possible future production among the various regions, it was assumed that persistent effort for self-preservation by existing mills would require production at least equal to installed capacity in each process in each region if this could be supported by the forests of the region. Beyond the limits of existing mill capacity prospective production was distributed with due regard for relative accessibility, quantity of standing timber, current and theoretical future annual growth of pulpwood species, suitability of species available in each region for the various processes, and total of consumption for all purposes, which, with losses, constitutes forest drain. Considerations with respect to the principal classifications of product are taken up in the following sections.

PULPWOOD FOR NEWSPRINT PAPER REQUIREMENTS

Newsprint paper is the most important single item in respect to volume of pulpwood requirements, and the most spectacular component of importations into the United States. At the same time it is most exacting in respect to wood sources as only a few species have been entirely satisfactory for newsprint paper. For these reasons it is desirable to give separate and primary consideration to requirements for pulpwood for newsprint paper.

In 1929 newsprint consumption reached a high of 3,813,000 tons, which is 75 percent of the 5,080,000 tons which Boyce estimates may be required in 1950. The manufacture of this prospective requirement would take about 3,985,000 tons of mechanical and 1,310,000 tons of sulphite pulp with an equivalent volume of about 6,600,000

cords of pulpwood, as compared to the 4,950,000 cord equivalent of 1929 newsprint consumption.

The total stand, current growth, amount cut for pulpwood, and total annual forest drain of the species suitable for newsprint are shown in table 8, along with present and possible future distribution of newsprint mill capacities. In this and subsequent tables the mill capacities shown have been compiled from Lockwood's Directory of the Paper Industry and include all mills reported, whether idle or not. The figures are used merely to illustrate the present distribution of the industry and not to indicate present effective or economic capacity. They are probably high in relation to practical normal operating capacity under actual working conditions.

From this table it will be seen that the newsprint mill capacity in 1934 was only 42 percent of the newsprint consumption in 1929 and was not much more than half the amount cut for all pulp uses of the species suitable for newsprint. The entire cut of southern pine pulpwood and more than half of the spruce, fir, and hemlock cut for pulpwood in the Lake region are used for other than newsprint purposes.

TABLE 8.—*Possible future contributions of forest regions to pulpwood requirements for newsprint, present mill capacities, and forest data relative to species suitable for newsprint*¹

[Thousand cords]

Region	(1) Possible distribution of prospective requirement	(2) 1934 news- print mill capacity (pulpwood equivalent)	(3) Total tim- ber stand	(4) Total annual forest drain 1925-29	(5) Annual cut for pulpwood 1925-29 ²	(6) Current annual growth
New England.....	1,000	951	63,066	2,073	1,232	885
Middle Atlantic.....	200	268	18,620	1,130	367	502
Lake.....	400	388	31,984	2,223	1,108	902
Central.....	-----	65	7,618	1,141	81	366
South.....	2,000	-----	165,861	9,145	754	11,063
Pacific coast.....	2,000	468	431,514	5,828	560	1,591
North Rocky Mountain.....	150	-----	80,934	646	25	711
South Rocky Mountain.....	100	-----	126,540	106	-----	426
Alaska.....	750	-----	166,944	164	-----	59
Total.....	6,600	2,140	1,093,081	22,456	4,127	16,503

¹ Includes spruces, true firs, hemlocks, and the following proportions of southern pine: One-fourth total in "stand" and "drain", one-third total in "growth", and entire amount in "cut for pulpwood."

² Includes all pulp uses of species suitable for newsprint.

A comparison of the amounts of the species suitable for newsprint cut for pulpwood with total forest drain of these species shows that only in New England and in the Lake region does the pulp industry assume the dominant position. Although it is apparent that there will always be some competition with other forest industries for the use of raw materials of these species, experience in the New England and Lake regions would indicate that pulp utilization will survive and tend to displace other uses when supplies become limited. Under normal market conditions it is also possible that as these species become more scarce, a larger proportion of pulp cut from them may be taken for newsprint. The situation in the New England and Lake regions also indicates that, even under intensive demand, the amount of these species cut for pulpwood may not be expected to exceed more than half the total annual drain.

OLDER REGIONS HARD PRESSED TO MAINTAIN NEWSPRINT PRODUCTION

In New England the cut and destruction of species suitable for newsprint has been averaging $2\frac{1}{2}$ times the estimated current growth. This is causing a rapid depletion of available growing stocks which will make it increasingly difficult for existing mills to survive and which points toward an increase rather than a decrease of imports for these mills. Since existing newsprint mill capacity could by itself absorb practically the entire current growth, it is evident that until forest management is successful in largely increasing the supply, such capacity can only be maintained locally by obtaining most other pulp manufactured in the region from other species and reducing still further the utilization of spruce, fir, and hemlock for other purposes. The possible future newsprint pulpwood quota for the region has therefore been estimated at only a little above present manufacturing capacity—1,000,000 as compared with 951,000 cords.

In the Middle Atlantic region the situation is even more acute. Very nearly all the spruce and fir cut in this region is used for pulp, and the newsprint-mill capacity is about 73 percent of the amount so used. A cut of over half a million cords of hemlock and a quarter million cords of yellow pine, largely in Pennsylvania and New Jersey, serves to bring the total forest drain of species suitable for newsprint to about three times the amount cut for pulp. Since newsprint mills in the Middle Atlantic region are all confined to the northern portion of New York State, it is not probable that any great part of the hemlock or yellow pine now cut for other purposes in the southern portion of the region will be diverted to the newsprint mills. Therefore present newsprint paper capacity in this region can only be maintained locally by greatly increasing the growth of spruce and fir through better forest management or by the more distant possibility of using northern hardwood for this purpose. It seems more than likely that imports of pulp from other regions, possibly to a large extent from the Pacific coast, would be needed to maintain existing mills, and the possible future production of pulpwood for newsprint is therefore placed at only 200,000 cords a year, which is about 25 percent below present manufacturing capacity. Even this is believed to be an optimistic figure, because in the effort to maintain mills in this region, the trend is to shift out of newsprint to other grades of paper.

For the Lake States a contribution of 400,000 cords of pulpwood is suggested, corresponding roughly to a newsprint-mill capacity of 388,000 cords. This capacity is less than half of the total drain on those species. Current growth of spruce and fir alone is in excess of newsprint plant capacity although less than the total drain of these species. Cut and destruction of hemlock is far in excess of growth. Although production may be largely confined to Minnesota, it should be quite feasible through forest management to maintain newsprint production in the Lake region equivalent to existing plant capacity, but the cut of hemlock for lumber and other purposes will probably be drastically curtailed in the near future.

Prospects for newsprint production in the Central States are not encouraging, and no definite contribution from that region is set up. The existing stand, already at a very low point, is being very rapidly reduced by continued cutting, far in excess of growth. Growth of spruce and fir in this region is almost negligible, and it seems unlikely that the industry will be developed here.

PACIFIC COAST AND ALASKA HAVE LARGE POTENTIAL PRODUCTION

Development of the newsprint industry in the Pacific region, although already on a scale commensurate with most of the eastern regions, is believed to be capable of much greater development. In view of the raw materials available there, a prospective annual contribution of 2 million cords of pulpwood for newsprint seems entirely reasonable.

The supply of hemlock, spruce, and true firs in the Pacific region reaches the enormous total of 431 million cords. Spruce and hemlock are very widely used for lumber, and it is to be expected that under normal conditions lumber production from these species will continue to exceed pulp production many times over for a long while in the future. But sawmill waste has already been used extensively for pulp in the Pacific coast mills and the proportion of the total cut so used has increased as lumber prices have declined. Furthermore, under the conditions of commercial logging in the forests of this region, tremendous quantities of waste material are left in the woods. Much of this is well suited for use as pulp. Its utilization would not only provide raw material for pulp mills at low cost but would greatly reduce the fire hazard on cut-over areas. In this region, as in no other, because of the large size of the timber, the large amount of material which cannot be economically utilized for lumber, and the existence of an established and active log market, the possibilities of integrating the pulp and lumber industries are tremendous. While current growth of species suitable for newsprint in the Northwest is at present only 1½ million cords a year, the immense stands of virgin timber still remaining and the possibilities of largely increased growth under effective policies of forest management give every indication that major newsprint developments may be maintained indefinitely in that region.

Pulpwood possibilities in Alaska are somewhat similar to those in the Pacific Coast States. The forests of southeastern Alaska appear to offer better prospects for development of the newsprint industry than for other branches of the paper industry or for lumber. The immense stand of spruce and hemlock timber suitable for newsprint pulp is in large part readily accessible to tidewater. Abundant water power is also awaiting development. Production may proceed whenever economic conditions are favorable and when once started may readily reach a total of 750,000 cords for newsprint annually, since it is estimated that the Alaskan forests could produce under forest management at least 1½ million cords per year in perpetuity.

In the Rocky Mountain region there also exist large quantities of timber suitable for newsprint, exploitation of which has not yet been undertaken. Conditions for development are not so favorable as elsewhere because the region is relatively inaccessible to large markets and because the forests occur generally at rather high elevations in the mountains, and are not concentrated in compact, continuous blocks. Nevertheless, should the Nation seek self-sufficiency in respect to paper and pulp, it should be possible to provide at least 250,000 cords of newsprint production from the two Rocky Mountain regions.

PROSPECTIVE DEVELOPMENT OF NEWSPRINT INDUSTRY IN SOUTH

Finally, the South holds possibilities for an expansion of the domestic newsprint industry several times more than sufficient to make up the balance of 2 million cords to satisfy prospective national requirements. Up to the present no newsprint mills have been established in the South, but the technique of conversion as described in an earlier section has been carried far enough to indicate the possibility of eventual, if not early, developments. The outstanding favorable factors in the southern situation are the extremely rapid growth which is occurring in the second-growth timber and the large areas of highly productive forest land, easily accessible for logging and located reasonably close to the principal markets of the country.

In presenting statistics on the possibilities of newsprint production in the South, it was considered that perhaps half the second-growth yellow pine would meet the requirement of being heart-free for this purpose; and since second-growth constitutes roughly half of the total present timber stand, only one-fourth of the latter appears in table 8 as growing stock to support potential production. In the case of current growth, the figures in the table include only one-third of the total for southern yellow pine, since this fraction is roughly equivalent to half of the estimated growth on second-growth, cordwood, and restocking areas. The same proportions were used for the southern pine reported in the Middle Atlantic and Central regions. On this reduced basis, the current growth of timber suitable for newsprint is estimated at more than 11 million cords a year. When it is remembered that present growth is far below ultimate possibilities for the region, it appears that as soon as commercial production from southern pine is demonstrated the South could easily supply as much of the 6,600,000 cords estimated as the total prospective future requirement for newsprint, as might not be more advantageously produced from the spruce, fir, and hemlock forests of the North and West.

SUMMARY OF NEWSPRINT SITUATION

That the forests of the Nation as a whole could easily supply present and prospective requirements for newsprint paper is convincingly shown by the statistics which have been presented. But expansion to replace current imports of paper and pulp for this purpose, as well as to meet increased requirements for the future, would have to come through an extensive development of the industry in the West, the South, and eventually in Alaska. Production in the older regions equivalent to existing plant capacities may be maintained from local sources only by the application of adequate measures of forest management to increase growth and provide a sustained yield and by devoting the production of spruce, fir, and hemlock more exclusively to newsprint paper.

PULPWOOD FOR MECHANICAL AND SULPHITE PROCESSES AS A
WHOLE

Because the spruces, firs, and hemlocks have been the principal sources of all mechanical and sulphite pulps as well as for newsprint which is likely to draw so heavily on the growth of these species in the older regions, it is desirable to discuss next aggregate requirements for all mechanical and sulphite pulps. Mechanical and sulphite

pulp products constitute nearly nine-tenths of all paper and pulp imports. The possible future requirement for these pulps as shown in table 7 is 18,500,000 cords a year, or nearly three-fourths of the total for all processes. This figure includes the 6,600,000 cords previously indicated as the prospective requirement for newsprint paper. It compares with 10,643,000 cords as the pulpwood equivalent of the 1929 consumption of these two classes of pulp. It anticipates an increase of almost 74 percent over the high point of consumption reached in that year, at which time only 36.8 percent of the amount used was produced within the country. To reach this figure existing mill capacity would have to be increased more than 2½ times.

In table 9 figures are given showing the tentatively assigned pulpwood quotas of each region to meet possible future mechanical and sulphite pulp requirements, together with a body of closely related forest and mill data. The species of wood represented in these figures include, in addition to the species suitable for newsprint, beech, birch, maple, aspen, cottonwood, yellow poplar, tupelo, jack pine, and eastern larch. All these woods have been successfully used in greater or less amounts in mechanical and sulphite pulps, and it is reasonable to assume that should the demand grow, they would come into more wide-spread use. In the interpretation of this table, it will be noted that comparable figures from table 8 represent the spruce-fir-hemlock or southern pine components of the totals, and that the hardwood component may be approximated by the differences between the two tables.

Although current growth is more than 1½ times the prospective requirements of pulpwoods suitable for mechanical and sulphite pulps, it is only about three-fourths of the total forest drain of these species. Therefore, unless far-reaching measures of forest management are applied in order to increase the total annual growth, it would not be feasible to accomplish the suggested increased use of this group of species without rapidly and dangerously depleting the remaining growing stocks.

TABLE 9.—Possible future contributions of forest regions to pulpwood requirements for mechanical and sulphite pulps, present mill capacities, and forest data relative to species suitable for the mechanical and sulphite processes ¹

[Thousand cords]

Region	Possible distribution of prospective requirement	1934 mechanical and sulphite mill capacity (pulpwood equivalent)	Total timber stand	Total annual forest drain 1925-29	Annual cut for pulpwood ² 1925-29	Current annual growth
	(1)	(2)	(3)	(4)	(5)	(6)
New England.....	2,600	2,219	205,787	4,132	1,420	3,181
Middle Atlantic.....	1,200	1,397	98,677	3,768	519	2,655
Lake.....	2,200	1,799	147,822	7,524	1,400	5,371
Central.....	500	-----	56,998	4,351	125	2,059
South.....	4,000	215	248,622	12,438	819	13,680
Pacific Coast.....	6,000	1,674	431,514	5,856	580	1,591
North Rocky Mountain.....	250	-----	80,934	646	25	711
South Rocky Mountain.....	250	5	126,813	123	-----	428
Alaska.....	1,500	3	166,944	164	-----	59
Total.....	18,500	7,312	1,564,111	39,002	4,888	29,735

¹ Includes spruces, true firs, and hemlocks, and the following proportions of southern pine: One-fourth total in "stand" and "drain", one-third total in "growth", and entire amount in "cut for pulpwood", together with beech, birch and maple, aspen and cottonwood, yellow poplar, tupelo, jack pine, and eastern larch (tamarack).

² Includes all pulp uses of species suitable for the mechanical and sulphite processes.

UTILIZATION OF HARDWOODS CAN SUSTAIN PRODUCTION OF OLDER REGIONS

If the regional situations are examined individually it will be noticed at once that the 2,219,000-cord capacity of mechanical and sulphite mills in New England exceeds the annual pulpwood cut of species suitable for these processes by 800,000 cords, or 56 percent. The possibilities of increasing the pulpwood cut of spruce, fir, and hemlock, which now supply about 87 percent of the total production, are so limited that it would be necessary to look to the northern hardwoods for the replacement of imports to New England mills. The prospects in this direction appear to be quite large, considering that the total stand and annual growth of all species suitable for the mechanical and sulphite processes in New England exceed the stand and growth of spruce, fir, and hemlock three times over. But annual drain for all purposes greatly exceeds total annual growth, and, besides, the total stand cannot be taken as entirely available for utilization because there is little prospect of exploiting much of the northern forests except by the driving of streams, and for this reason much of the hardwood will remain inaccessible. While much second-growth timber and hardwood not suitable for lumber is pressing for a market at present, a material increase in the pulpwood supply could come only through increased growth. By proper treatment it is probable that current growth could be doubled, which would permit a continuation of current utilization of the species in this group for other purposes than pulp and still make possible a production of mechanical and sulphite pulp substantially in excess of existing plant capacity. An ultimate total of 2,600,000 cords, of which almost one-half might be of hardwoods, is suggested, but more immediate possibilities would probably not exceed 2,000,000 cords. Such a development would be entirely consistent with the character of the forest and its proximity to markets.

For the Middle Atlantic region an ultimate contribution of 1,200,000 cords of pulpwood for the mechanical and sulphite processes is suggested. Here, where the situation with respect to spruce and fir is especially acute, there is also opportunity for development by utilization of hardwoods. The existing mill capacity of 1,397,000 cords in the mechanical and sulphite processes, while almost three times the current annual cut for pulpwood, is only about 53 percent of the current annual growth. But utilization for other purposes and losses raise the total forest drain to nearly one and a half times the estimated current growth, so that here again forest management would be essential to any effort to meet pulpwood requirements locally on a permanent basis.

For reasons similar to those which apply in New England, it would be desirable to expand the production of pulpwood for the mechanical and sulphite processes in the Middle Atlantic region at least up to the level of present mill capacities, but it is doubtful if this could be accomplished because the existing growing stock is too small to provide much increased growth for many decades. It is not anticipated that local production will exceed the contribution of 1,200,000 cords indicated, of which about two-thirds might be hardwoods, so that to maintain existing capacity the sulphite and mechanical mills of this region would have to look to other regions for the equivalent of at least 200,000 cords a year, or else continue to import from other

countries. Without dependence upon imports, a shift of mills to other regions would be inevitable if hardwoods could not be utilized to the extent indicated.

In the Lake States, potential growth of pulpwood may be capable of supporting a mechanical and sulphite pulp production somewhat in excess of present capacity, or perhaps 2,200,000 cords a year, of which almost half might be hardwood. Existing mill capacity is about 400,000 cords in excess of annual cut for pulp. A relatively small stand of spruce and fir barely able to hold its own is supplemented by large quantities of beech, birch, and maple, extensive areas of young and rapidly growing aspen, and substantial resources of jack pine. Because of the contribution of the aspen, the current growth of more than $5\frac{1}{2}$ million cords is much larger than that estimated for New England, although the timber stand is not quite three-fourths as great, and total drain exceeds growth by about 40 percent.

Because of the very large areas at present making relatively small contributions to growth in the Lake States, the possibilities of increasing future growth and potential production are proportionately large. Under proper management, annual growth may easily exceed $2\frac{1}{2}$ times the current rate, but it would be necessary to build up the growing stock to at least double the volume of the present timber stand before any material increase in total production can be expected. In the meantime, the utilization of hardwoods for pulp could contribute immediately toward the maintenance of existing pulp mills.

In the central region, because of extremely limited stands of spruce, fir, and hemlock, the possibilities for mechanical and sulphite pulp production are restricted almost entirely to hardwoods. The annual drain of over 4 million cords is more than double the current growth. Should the use of hardwoods for these processes become widespread, it is not unreasonable to suppose that the forests of the central region might contribute a limited amount of wood, possibly 500,000 cords a year, much of which might be shipped to plants in the Middle Atlantic region.

In the South the addition of beech, birch, and maple, yellow poplar, and tupelo gum, increases materially the available resources for the production of mechanical and sulphite pulps over the figures given for newsprint. The considerations involved would however be the same. Likewise in the western regions and Alaska the situation with respect to all uses for mechanical and sulphite pulps is essentially the same as for newsprint, since no new species other than cottonwood, which is of minor importance, are involved. However, it appears that a more extensive development of the industry in the South, the West, and in Alaska would be called for if the total prospective requirements for these pulps are to be met by domestic production. The possible extent of such increased production is indicated in table 9, where a quota of 4 million cords, of which perhaps 1 million may be hardwoods, is suggested for the South, $6\frac{1}{2}$ millions cord for the West, and $1\frac{1}{2}$ million cords for Alaska. These figures are well within the sustained yield capacities of the respective regions and are set up with due consideration for relative accessibility, competitive market situations, and probable continued preference for spruce, fir, and hemlock on the part of many mill operators.

SUMMARY OF MECHANICAL AND SULPHITE PULP SITUATION

It is believed that through the utilization of hardwood, production of mechanical and sulphite pulps in the Eastern regions might be increased from $3\frac{1}{2}$ or 4 million cords, to perhaps $6\frac{1}{2}$ million cords a year, which would be only about 1 million cords in excess of present mill capacity. But such a production could only be sustained along with other normal uses for the species suited for these processes, if growing stocks were built up through forest management to yield a growth almost double that which is being obtained at present.

About 35 percent of the possible future requirements of $18\frac{1}{2}$ million cords might thus be supplied in the older regions. Extensive exploitation of the tremendous resources of pulp timber in the West might yield a like amount, and cutting up to the estimated sustained yield capacity of Alaska might add another 8 percent or a million and a half cords. Development of a ground-wood and sulphite industry in the South might contribute the final 22 percent, or 4 million cords, which would be required if the country were ultimately to become independent of imports in this field.

It is perhaps worth while giving consideration to how the situation might be met if the successful development of sulphite and ground-wood pulps from southern pines predicated in the foregoing discussion should not materialize. Failure of the sulphite process for southern pines might be offset in part by much wider use of improved sulphate pulps, a tendency already much in evidence. It might also stimulate a more extensive use of hardwoods in the sulphite process, the available volume and growth of hardwoods in the South being able to supply much larger quantities of pulp than the million cords suggested in connection with table 9. Both of these tendencies would indicate that a substantial part of the production suggested for the mechanical and sulphite processes in the South might remain in that region even though the sulphite process should not prove successful with southern pine. But if self-sufficiency were to be achieved, it would become necessary for the Nation to draw more heavily on the hemlock, true firs, and spruces of the West and Alaska. This, in turn would probably imply devoting the available growth of these species almost entirely to sulphite and mechanical pulps and depending upon the western pines and Douglas fir for sulphate pulp in the West.

Self-sufficiency at the 1929 level of consumption for mechanical and sulphite pulp products might be attained by increasing production in the East through the utilization of hardwoods to about 5 million cords, which would still be somewhat less than existing mill capacity, and by expansion of the industry in the West and in the South to supply about 4 million cords more than the $1\frac{1}{2}$ million which the West is now equipped to contribute.

PULPWOOD FOR THE SULPHATE PROCESS

The sulphate-pulp situation is a matter of special importance in supplying national needs because the consumption of the principal products made from sulphate pulp, especially boards, has been increasing so rapidly and because through refinement of the process the prospect of using sulphate pulp in a much wider variety of products than heretofore is so bright. This situation is of special significance also because imports of sulphate pulp have been assuming such large

proportions in recent years. A rapid rise during the decade prior to 1929 brought imports up to the equivalent of 850,000 cords of wood in that year. Imports of this type of pulp have again surged rapidly forward during 1933 and 1934 after maintaining a more moderate rate of increase throughout the early years of the depression.

Possible future requirements for sulphate have been placed at the equivalent of 5 million cords of wood. This compares with existing mill capacity of about 2,720,000 and 1929 consumption equivalent to 2,549,000 cords. It is a conservative figure in the light of present trends, but a greater figure is not used because it is thought that production of sulphate pulp in excess of this amount may be largely at the expense of sulphite production, especially in the South and West.

The suggested regional distribution of pulpwood production and the pertinent forest statistics regarding the species suitable for sulphate pulp, which include practically all conifers, are given in table 10. It will be noted that this group of species supplies the bulk of the Nation's lumber requirements, so that for the country as a whole neither the present nor the possible future amounts cut for pulp by all processes for which they are suited amount to any large proportion of the total forest drain. Since pulp utilization may be advantageously integrated with lumber production, there should be no question as to the ability of our forests to supply 5,000,000 cords of sulphate without detriment to other industries.

But the heavy demand which prospective requirements for mechanical and sulphite pulps place on the forests of the Northeastern regions makes it unlikely that sulphate-pulp production in these regions will greatly exceed present mill capacities, at least for several decades. Eventually use of jack pine and rebuilding of the forests of the Lake region may permit substantially greater output there. On the other hand forest conditions are favorable for greatly increased production in the South. Considering that only one-fourth of the stand and one-third of annual growth of southern pines were included as the basis for a possible 3 million cord cut of mechanical and sulphite pulp from these species, a production in the South of 3 to 3½ million cords for sulphate pulp should be easy to maintain.

TABLE 10.—Possible future contributions of forest regions to pulpwood requirements for sulphate pulps, present mill capacities, and forest data relative to species suitable for the sulphate process ¹

[Thousand cords]						
Region	Possible distribution of prospective requirement	1934 sulphate mill capacity (pulpwood equivalent)	Total timber stand	Total annual forest drain 1925-29	Annual cut for pulpwood ² 1925-29	Current annual growth
	(1)	(2)	(3)	(4)	(5)	(6)
New England.....	150	72	94,783	3,741	1,232	1,800
Middle Atlantic.....	50	-----	42,155	2,441	367	1,230
Lake.....	600	477	64,085	4,371	1,329	1,839
Central.....	-----	-----	16,716	4,041	81	729
South.....	3,200	1,706	668,649	39,000	754	33,098
Pacific Coast.....	1,000	409	2,067,553	38,882	570	7,413
North Rocky Mountain.....	-----	56	498,384	6,232	25	4,599
South Rocky Mountain.....	-----	-----	350,985	1,706	-----	2,013
Alaska.....	-----	-----	176,675	170	-----	59
Total.....	5,000	2,720	3,979,985	100,584	4,358	52,780

¹ Includes spruces, true firs, hemlocks, white pine, Norway pine, jack pine, all western and southern pines, Douglas fir, redwood, cypress, eastern and western cedars, and eastern and western larch.

² Includes all pulp uses of species suitable for the sulphate process.

The possible future requirement would be completed if present sulphate capacity in the Pacific region were increased to reach about 1,000,000 cords a year. Although the 6,000,000 cords of mechanical and sulphite pulps which the Pacific region may contribute would call for rather intensive development of the industry in this region, it is considered that the available stands and growth possibilities are sufficiently large to permit some expansion of sulphate production also.

PULPWOOD FOR SODA AND SEMICHEMICAL PROCESSES

Although aspen and cottonwood are now the chief species pulped by the soda process, a wide variety of woods may be used. The semi-chemical processes are also capable of converting almost any hardwood species, although limited in their field of use to the lower quality papers. Present capacity in the two processes is equivalent to about 1½ million cords of wood annually, and it is hardly likely that prospective requirements will exceed 1½ million cords. In any such large-scale expansion of domestic pulp production as would be necessary to make the United States independent of imports, there would be no question of the ability to maintain the limited and somewhat static output of these pulps. There is a possibility, however, that some interregional shipment of wood or shifting of mill capacities would have to be effected, since about 45 percent of existing soda mill capacity lies in the Middle Atlantic region, where pulpwood supplies will hardly be sufficient to meet prospective requirements for the mechanical and sulphite pulp mills.

PULPWOOD FOR ALL PULP PROCESSES

Having considered the requirements for the principal classes of pulp separately, the situation may finally be viewed with respect to aggregate requirements for all pulp uses. Table 11 gives data for all pulpwood species in the same form as has previously been used for the groups of species suitable for specific processes, and in addition, a column has been added to show theoretical growth of all species suitable for pulpwood which might be attained in each region under the possible development of forest management suggested in the Copeland report (pp. 231 and 232). Some of the relationships are shown graphically in figures 10, 11, and 12, on the following pages.

TABLE 11.—Possible future contribution of forest regions to aggregate pulpwood requirement, present mill capacities, and forest data relative to species suitable for all pulp uses,¹ including theoretical future growth

[Thousand cords]

Region	Possible distribution of prospective requirement	1934 pulp mill capacity (pulp-wood equivalent)	Total timber stand	Total annual forest drain, 1925-29	Annual cut for pulp-wood, 1925-29	Current annual growth	Theoretical future growth of all pulp species
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
New England...	3,250	2,523	238,255	5,816	1,426	4,102	7,053
Middle Atlantic.	1,500	1,949	127,073	5,136	529	3,497	5,621
Lake.....	3,200	2,360	193,954	9,421	1,432	6,482	16,052
Central.....	500	120	99,871	10,371	174	3,864	6,382
South.....	7,500	2,226	869,313	45,229	853	39,219	72,563
Pacific coast.....	7,050	2,128	2,100,246	39,103	590	7,500	22,557
North Rocky Mountain.....	250	56	500,381	6,232	25	4,622	5,228
South Rocky Mountain.....	250	5	359,844	1,716	-----	2,078	2,318
Alaska.....	1,500	3	176,675	170	-----	59	1,500
Total.....	25,000	11,370	4,665,612	123,194	5,029	71,423	139,274

¹ Includes all commercial species except oak, ash, walnut, hickory.

SOUTH AND PACIFIC COAST REGIONS DOMINATE PROSPECTIVE FUTURE PRODUCTION

The future production suggested for the New England and Lake States regions, about $3\frac{1}{4}$ million cords each, is approximately two and one-fourth times their average annual output of pulpwood for the period 1925 to 1929, while that for the Middle Atlantic region, $1\frac{1}{2}$ million cords, is almost three times the 1925-29 cut (see fig. 11). The ability of these three older regions to make such future contributions to the pulp industry is contingent upon the wide-spread use of species other than spruce and fir. But restoration of the forests of the Lake region where operating and market conditions are favorable

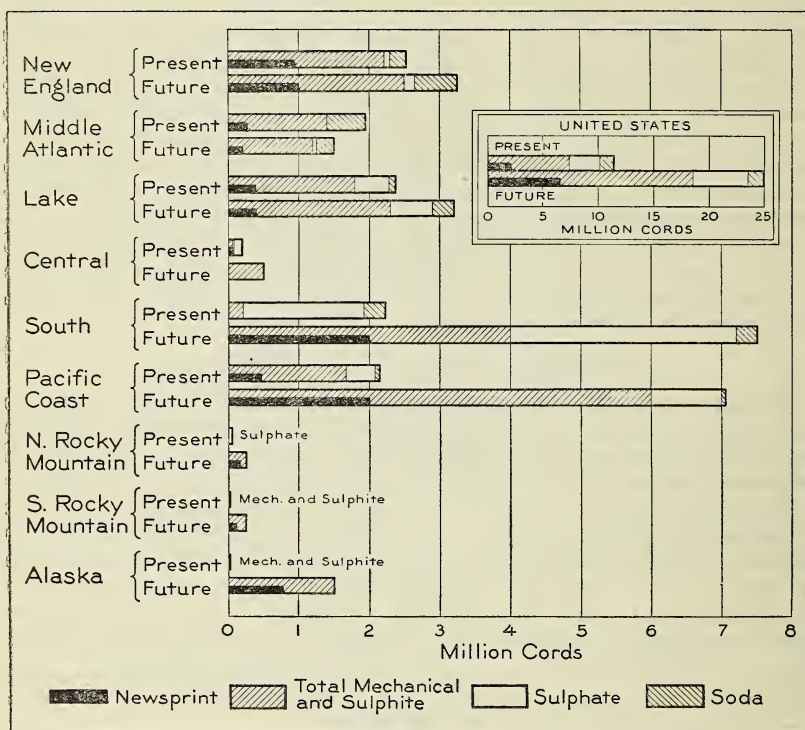


FIGURE 10.—Existing pulp-mill capacities and possible future pulp production.

may eventually permit production there to assume relatively larger proportions than indicated in table 11. When all suitable species are taken into account, as they are here, the suggested pulpwood production for the three regions is only a little more than half the present annual growth and only about 28 percent of the growth considered attainable under forest management (see fig. 11). The theoretical future growth in these regions is in fact sufficiently great to maintain the suggested increase in pulpwood production along with a volume of production for other uses at least equal to the total annual drain for the 1925-29 period (see fig. 11). But as will be shown later growing stocks would have to be built up substantially to insure this production on a sustained-yield basis.

The half-million-cord pulpwood cut suggested for the Central region is only a small fraction of the growth assumed as possible for this region (fig. 11), but current annual drain has been greatly in excess of this theoretical growth figure, and the stand is now far below the minimum volume needed to sustain it. It is therefore clear that the total rate of cut and destruction in the Central region must be drastically reduced, but the shift of other industry which this implies would probably have little influence on the limited amount of pulpwood involved.

Conditions in the South are of particular interest, because it would seem as though this region might easily supply at least one-third of

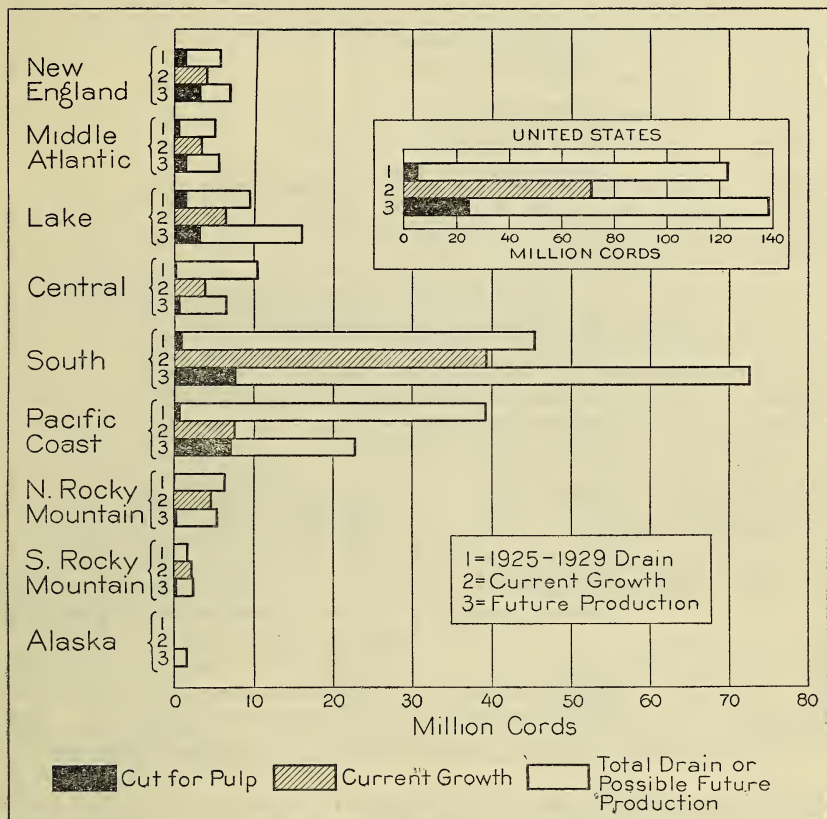


FIGURE 11.—Current pulpwood cut, total drain, and growth, in relation to the theoretical future pulpwood cut and growth of species suitable for pulp.

the country's prospective total pulpwood requirements. The production of 7½ million cords suggested for the South, although more than a million cords greater than the pulpwood production of the entire country at the high point reached in 1929, is not large in comparison with the present and potential annual timber growth of the region (fig. 11). It is true that total annual forest drain in the South has averaged more than 45 million cords, which is substantially in excess of a current growth estimated at about 39 million cords. But under proper forest management, the annual growth of species suitable

for pulpwood in this region might reach 72½ million cords. Obviously the country could continue to lean heavily on the South for timber requirements for all purposes if timely measure were adopted to conserve the forest resource on a sustained-yield basis. It is significant, however, that uncontrolled exploitation and lack of protection have already reduced the timber stand to amounts far below the minimum growing stock needed to maintain the indicated theoretical growth on a saw-timber rotation.

The Pacific coast region is likely to vie with the South for leadership in pulpwood production should the Nation move toward self-sufficiency in this field. Its suggested production of 7 million

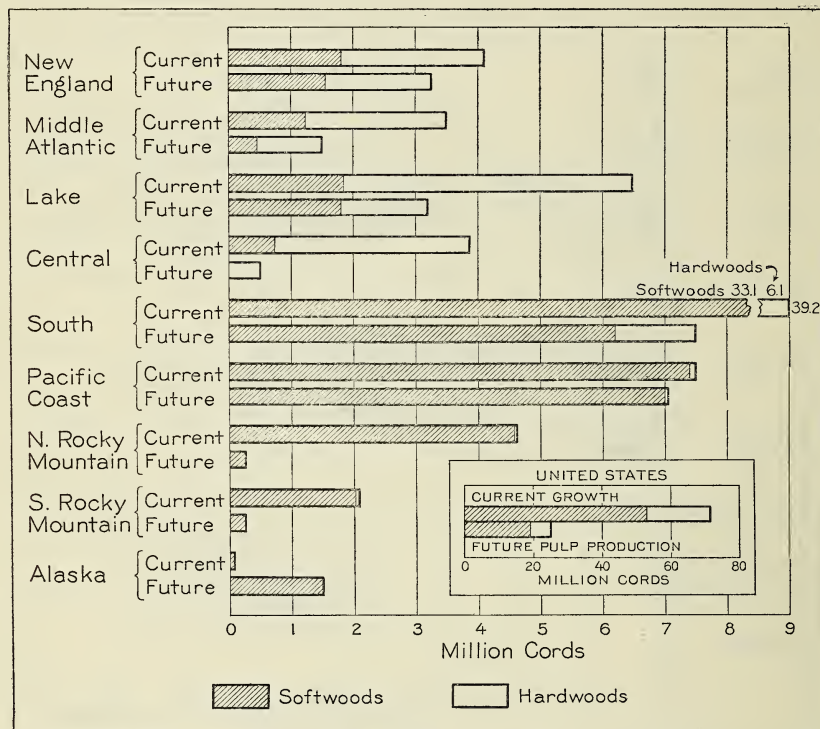


FIGURE 12.—Current growth and possible future pulp production of species suitable for pulp.

cords is 28 percent of the total prospective requirement for the entire country. Development of pulpwood production there is likely to be more intensive in relation to other uses than in the South because the Pacific coast stands contain so large a proportion of spruce, fir, and hemlock, which are suitable for newsprint and for which demand will probably continue to be most active. This difference is seen in the respective quotas of pulpwood suggested for the two regions as compared with their theoretical future growth of pulpwood species as indicated in figure 11. For the Pacific coast region, pulpwood production is placed at almost one-third of total theoretical growth, while in the South the proportion barely exceeds one-tenth. But total annual forest drain of 39 million cords in the Pacific coast

region is substantially greater than the indicated theoretical growth. Continuation of this high rate of cutting is justified in consideration of the large stand of virgin timber still awaiting utilization, and while it continues, the suggested pulpwood production would not constitute more than 18 percent of the total drain.

The total prospective requirement might be completed by annual contributions of $1\frac{1}{2}$ million cords from Alaska and half a million cords from the Rocky Mountain regions. Because of its quality and accessibility to tidewater and power, the Alaskan timber may sooner or later be extensively used for pulpwood. On the other hand, because of the relatively unfavorable conditions as to accessibility of timber, costs of operation and potential market outlets, developments in the Rocky Mountain is likely to be moderate, and the suggested production is conservative in relation to available stands and growth possibilities.

EXISTING PULP MILL CAPACITY IN RELATION TO CURRENT PAPER AND PULP CONSUMPTION

Existing pulp-mill capacity for the country as a whole is sufficient to take care of consumption at the rates which have obtained during the depression. Although about 30 percent short of 1929 consumption with respect to mechanical and sulphite pulps, present mill capacity could supply the amounts of sulphate and soda pulps consumed in that year. Yet imports still supply the equivalent of more than half the entire market for paper and pulp. Evidently the immediate need is as much for reduction of costs in existing mills to permit them to compete with production from Canada and northern European countries, as for the construction of new mills. However, improving the competitive situation may involve construction of modern mills capable of operating at low cost to replace obsolete or high-cost mills. This may result in some regional shifting of production capacities, even though the preceding analyses of present and possible future production indicates that, with the exception of the Middle Atlantic region, existing pulp mills may be supplied with raw materials from forests in their own region.

The current shortage in mechanical and sulphite capacity might be promptly covered by developments in the Northwest, and an unmistakable trend in that direction is now in evidence. If prospective pulp and paper requirements were to be met on a basis of national self-sufficiency, pulp-mill capacity would eventually have to be more than doubled. (See fig. 10.)

PROSPECTIVE PULPWOOD PRODUCTION IN RELATION TO LOCATION OF PAPER MILLS

It is also of interest to consider how the suggested possible future production by regions would harmonize with the present distribution of paper mills, especially those known as "converting" mills, which depend upon the open market for pulp supplies. The figures given in table 12 will throw a light on this situation. In order to put paper-mill and pulp-mill capacities and prospective pulp-wood production on a comparable basis, all are shown in terms of wood-pulp tonnage.

TABLE 12.—*Present paper-mill and pulp-mill capacities and prospective pulpwood production*

Region	Approximate wood pulp equivalent of present paper-mill capacities	Percentage of paper capacity in converting mills	Present pulp-mill capacity	Approximate wood pulp equivalent of prospective pulpwood production
	(1)	(2)	(3)	(4)
	<i>M tons</i>	<i>Percent</i>	<i>M tons</i>	<i>M tons</i>
New England.....	1,623	50	1,692	2,070
Middle Atlantic.....	2,363	70	1,344	1,040
Lake.....	1,756	53	1,492	2,150
Central.....	1,761	93	85	320
South.....	941	29	1,284	4,260
Pacific Coast.....	637	33	1,278	4,670
North Rocky Mountain.....			31	200
South Rocky Mountain.....	9		5	200
Alaska.....			4	1,200
Total.....	9,090	61	7,215	16,110

It will be seen that in the Middle Atlantic and Central regions paper-mill capacity is far in excess of the possible pulp production from raw material originating in those regions. In the New England and Lake regions, although about half of the total paper capacity is now in mills which depend on purchased pulp, pulp-mill capacity is nearly sufficient to supply the whole demand, and possible production should be fully adequate for these converting mills.

Deficiencies in the Central region could be easily balanced by pulpwood shipments from the South, while the Middle Atlantic region might supply its deficiency in part from New England and the Lake States. But since much of the possible Pacific coast production might reach Middle Atlantic ports by water shipment as at present, it is probable that western pulps could supply a large part of the deficiencies in the Middle Atlantic mills, leaving any excess in the Lake States largely available for consumption in the Central region. However the situation might be worked out, it would not seem that mills now dependent upon purchased pulp should be faced by materially increased costs if all their raw materials were supplied from the forests of the United States.

FORESTRY MEASURES WHICH WOULD BE REQUIRED TO MEET PULPWOOD AND OTHER TIMBER REQUIREMENTS

PULPWOOD SUPPLY AN INTEGRAL PART OF GENERAL FORESTRY PROBLEM

A program of forestry for the Nation aimed at domestic self-sufficiency would need to be so directed and coordinated as to assure to all wood-using industries sufficient timber for prospective requirements, accessibly located and of size and quality suited to their needs. The production of the Nation's pulpwood requirements is so interrelated with the use of land for other purposes, including agriculture, that it cannot properly be treated as an isolated problem, nor can it be segregated from the requirements of other wood-using industries. Theoretically it might be possible to set aside sufficient

land for the production of the country's pulpwood requirements without respect to other industries, but such a proposal would imply not only complete and permanent control over the lands devoted to this purpose, but also the practice of sustained yield management on them. Even then the pulpwood situation would be essentially a single element in the general forestry problem and would necessarily be subject to much the same considerations.

It is a well-established fact that the forests of the United States will not be capable of supporting for long the industries now dependent upon them if the rate of depletion continued to exceed growth by a wide margin. Maintenance of the forest industries on their present scale would require not only public forestry but also the early and wide-spread adoption of forestry measures on forest lands in private ownership throughout the country. Under these conditions there would be small economic advantage in meeting pulp and paper requirements if to do so meant serious curtailment sooner or later of other forest industries, as would be the case if the pulp and paper industry were expanded without consideration of forestry measures.

The question of domestic self-sufficiency in pulpwood clearly involves the problem of how domestic production of present and prospective pulpwood requirements would fit in with the satisfaction of other timber needs of the Nation. For this purpose certain aspects of the national forestry situation, which have been given exhaustive treatment in the Copeland report, may be reviewed to advantage.

In the first place it is unlikely that the total demand upon the forests of the Nation as a whole for wood for all uses would be increased above the amount which they now supply, even should domestic pulpwood production be increased to 4 or 5 times its current volume. Consumption trends for all products, as analyzed in the Copeland report, indicate a total normal wood requirement approximately the same as the average annual forest drain for the 1925-29 period, namely, about 16½ billion cubic feet, or the equivalent of about 183 million cords. This normal requirement is defined as the volume of use when consumers are afforded a reasonable latitude in choice of readily available materials and when general economic conditions are such that the Nation is conscious neither of depression nor of unusual prosperity. In this normal requirement a possible increase of some 20 million cords in pulpwood would probably be offset by further decline in certain other uses (principally lumber) and by reduction of losses from insects and disease. The problem would therefore be to maintain total forest production (growth) on the 183 million cord level.

In the second place, it seems altogether probable that the best results in forest management would be achieved and that the normal requirements of the country for forest products would best be met if regional and national programs of forestry were based upon saw timber as the major object of management and, if sufficiently long rotations are used, to produce timber of considerable size and relatively high quality. To an increasing extent forests managed for saw timber may also serve as a potential source of pulpwood and the possibilities in this direction will be considered in more detail later. This principle is stated without prejudice to efforts to establish sustained-yield units on pulpwood rotations or other short rotations to meet the needs of industry in particular areas, where, for example, the character or

location of the forest is such as to make management for saw timber undesirable or out of the question. The results of such management can only be beneficial in that they tend to place each unit concerned in a stable condition, but they would necessarily become only a minor factor in a Nation-wide forestry program capable of supplying substantially the whole volume of timber consumption. Such a program would have to provide for lumber requirements far greater in volume than pulpwood requirements, and saw timber is the only source of lumber. Furthermore, European experience, substantiated by an increasing volume of evidence in this country, points to the conclusion that even when forests are organized solely for pulpwood or other products which can be manufactured from trees of small size, best results will be obtained if the timber is grown to fairly large size under relatively long rotations with selective cuttings arranged to go over the same ground at relatively frequent intervals. One advantage of this system lies in the fact that the effective production of the land is increased when growth is largely concentrated on stems of merchantable size rather than being dissipated in saplings and brush which cannot be utilized. There is also an advantage in operating costs, because the proportion of small-sized material, the cost of handling of which is greater in all forms of utilization, is kept at a minimum.

EXISTING GROWING STOCKS GENERALLY INADEQUATE

A forest organized and managed to provide by growth a stable and ample supply of usable timber for any industry or group of industries is said to be on a sustained-yield basis, and the volume of material present as the basis for management is known as the growing stock. If the amount of growing stock in each age class from seedlings up to maturity is sufficient to supply annual requirements in successive years for the future, annual cut will be equal to annual growth. Obviously, within the limits of the productive capacity of the soil, the size of the annual cut which may be permanently sustained is directly dependent upon the volume and age distribution of growing stock.

Where there is a large surplus of mature and overmature timber, the rate of cutting can exceed the growth until the surplus is used up without violating the principle of sustained yield. The cutting of this surplus should, of course, be extended over a sufficient number of years to permit the existing young stands and reproduction following cutting to mature in a sequence which will permit cutting to continue without interruption, whether this new growth is on separate areas, as in clear cutting, or intermingled with residual growing stock, as in selective logging. Where there is a serious deficiency in mature timber and timber approaching maturity, as in the East, continued cutting of timber in excess of the annual growth will sooner or later exhaust the supply of saw timber that is large enough for economic utilization.

It is therefore futile to consider total quantities of standing timber as available for use. Experience in the older regions shows clearly that to do so results in a loss of forest industries long before the standing timber is completely removed. Continued overcutting results in a steady deterioration in the character as well as the quantity of

the available growing stock, so that the remaining stand becomes more and more scattered and less and less attractive to prospective users.

Forest industries cannot be sustained permanently unless sufficient standing timber or growing stock is available in reasonably compact units to produce annually in growth of usable size the quantities of wood they consume each year.

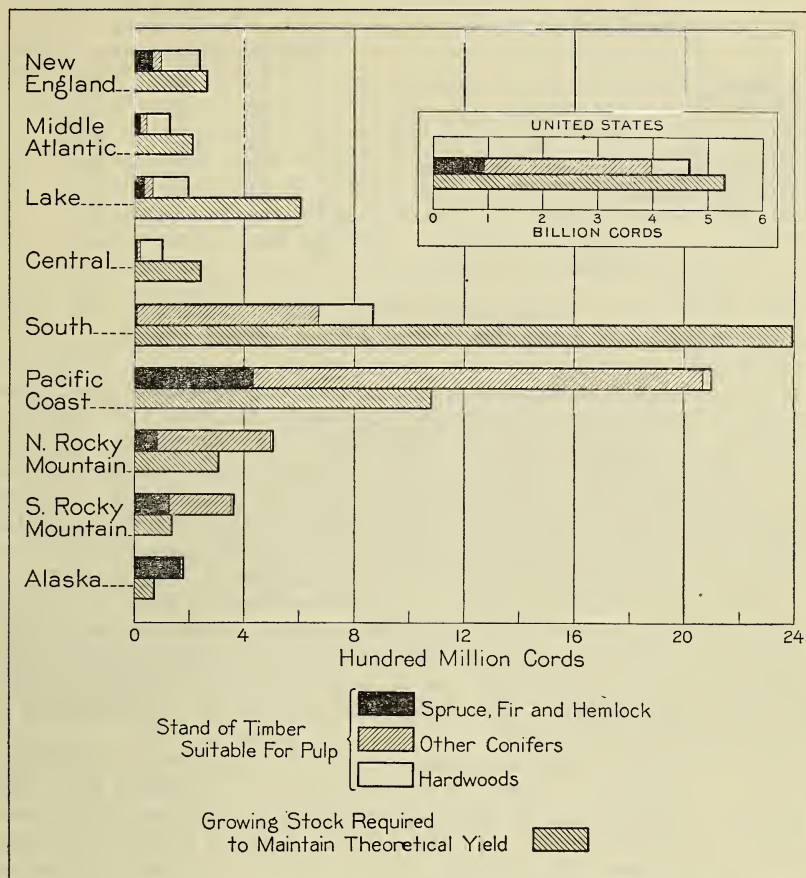


FIGURE 13.—Stand of timber suitable for pulp, and required growing stocks.

The possibility of maintaining existing cutting rates with respect to species suitable for pulpwood and the urgency of adopting measures to increase forest growth in the various regions will be indicated by a comparison of existing stands with the minimum growing stocks needed to maintain the theoretical distribution of needed future growth set up in the Copeland report. The statistics are shown in table 13, and figure 13. They cover requirements for lumber and all other uses as well as pulp, but apply only to those species previously classified as being suitable for pulp utilization.

TABLE 13.—*Comparison of existing timber stands of species suitable for pulpwood with minimum growing stocks required to maintain theoretical growth adequate to meet future requirements for all products*

Region	Theoretical future growth	Growing stocks required	Present forest stands	Ratio of present to required growing stocks
	(1)	(2)	(3)	(4)
	Million cords	Million cords	Million cords	Million cords
New England.....	7.1	264	238	0.9
Middle Atlantic.....	5.6	211	127	.6
Lake.....	16.0	602	194	.3
Central.....	6.4	239	100	.4
South.....	72.6	2,394	869	.4
Pacific coast.....	22.6	1,083	2,100	1.9
North Rocky Mountain.....	5.2	305	500	1.6
South Rocky Mountain.....	2.3	135	360	2.7
Alaska.....	1.5	72	177	2.5
Total.....	139.3	5,305	4,665	.9

The figures for "required growing stocks" shown in this table are premised on an even distribution of age classes, whether in even-aged stands or under selective management; no cutting except for salvage, thinnings, and other improvement cuttings until the timber reaches rotation age; and measures adequate to protect the growing stock and to obtain prompt regeneration after logging. Rotation ages were assumed as 60 years for softwood in the South, 80 years for hardwoods in the South, and for all species in the other Eastern regions, 100 years in the Pacific coast region and in Alaska, and 120 years in the Rocky Mountain regions. It may be argued that these rotations are needlessly high for the production of pulp timber, but in considering all timber needs, rotations sufficiently long to produce sizable saw timber would be necessary, and for the reasons already stated it is believed advantageous, economically wise, and possibly necessary, to carry timber to the ages indicated and to integrate the production of pulpwood to a large extent with the management of forest land for saw timber.

It would appear that the present volume of timber in New England, if it should all prove to be economically available and were properly distributed as to age classes, would almost sustain the indicated theoretical growth. In the Middle Atlantic region, under the same assumptions, the present stands would have to be increased about 65 percent. In the Lake region the present stand is less than one-third of that which would be required to achieve the indicated sustained production, while in the South and Central regions approximately two and one-half times the present growing stocks are needed.

In the West and in Alaska, on the other hand, existing stands appear to be considerably in excess of the volume of regulated growing stock needed to maintain the sustained yield suggested as their possible contribution toward the Nation's future timber requirements. It is worth mentioning that the theoretical growth in the Pacific coast region is less than 60 percent of the 1925-29 rate of forest drain, so that if the current volume of production of all timber products were to be continued indefinitely, a much larger growing stock would be required than that indicated in table 13 and there would be practically no apparent surplus.

WIDESPREAD APPLICATION OF SCIENTIFIC FOREST MANAGEMENT WOULD
BE REQUIRED

In arriving at the distribution of a theoretical growth adequate to meet possible future timber requirements, it was assumed that, in each region, some combination of intensive forestry, extensive forestry, and simple protection against fire would be in line with probable realities.

It is believed that the play of economic forces will lead to the practice of intensive forestry on the most favorable situations before anything more than fire protection would be economically justifiable upon the poorer and more remote lands. At the same time, because of ownership or other factors, certain lands will be given little, if any, forestry treatment even though physically and economically suited to it. Achievement of the theoretical growth which has been set up would involve, for the country as a whole as suggested in the Copeland report, the practice of intensive forestry on perhaps 70,000,000 acres, extensive forestry on 279,000,000 acres, and protection against fire to prevent serious losses at any time on all the remaining forest lands.

In considering the growth rates which might be attained under management, extensive forestry is defined as embracing, in addition to simple fire protection, such cutting practices or simple silvicultural measures as are necessary to maintain production in sufficient quantity for commercial utilization. It would include, as occasion required, such measures as deferring cutting until reproduction has become established, slash disposal as an aid in fire protection, the preservation of advance reproduction, the leaving of seed trees, prevention of overgrazing, and girdling of inferior trees to permit valuable young growth to develop. It would not ordinarily include planting.

Intensive forestry is meant to denote a very high degree of protection against fire, insects, and disease. In addition, it would require cutting practices and various cultural measures, including planting, to increase both the quantity and quality of the yield to a point consistent with the productive capacity of the land. All of the areas under intensive forestry, therefore, would be in a good growing condition and well stocked with desirable species.

Obviously, extending the practice of forestry to anything like the areas indicated and building up growing stocks in the East to about two and one-half times their present volume constitutes an objective which would require a long time, probably 60 to 80 years at least, before anything approaching full accomplishment could be realized, and which in any event would demand the best efforts of all agencies in all lines of forestry activity. Especially important would be the extent to which adequate forestry measures were applied on the privately owned timberlands of the country, which constitute about 60 percent of the total commercial forest area and which must be depended upon to produce the bulk of the Nation's future timber needs.

CONSERVATIVE UTILIZATION WILL HELP

The deficiencies in growing stocks indicated for the South, Central, Lake, and Middle Atlantic regions appear so serious that, even allowing for sizable inaccuracies in stand and growth estimates, a con-

siderable decline in the total cut of all forest products in those regions is inevitable, irrespective of the existing economic depression. Indeed, the considerable reduction in forest drain which has accompanied the depression of the past few years may be providential from the standpoint of the welfare of the forest resources.

The severity and duration of this decline in cut, and its ill effects nationally, regionally, and locally, might be minimized in a number of ways. Further restricting abnormal losses by fire and other causes would serve to reduce the rate of depletion of the growing stock and facilitate the restocking of cut-over areas. Better utilization methods, more efficient marketing, and the accompanying reductions in waste would make it possible to cut a given quantity of usable products from a smaller volume of timber. Obtaining products other than lumber, as far as practicable, from improvement or salvage cuttings and using defective trees or portions of the stand which now go to waste incident to saw-timber production, would help build up the growing stock.

The yield of usable growth could also be increased by careful selection of the stands to be cut and of the trees to be cut within those stands where partial cutting methods can be applied. Those stands and trees should be cut which offer less prospect of making a good rate of growth in volume or value, and those should be left which promise to increase rapidly in volume or value in the comparatively near future. Partial cutting or selective logging should be the general rule.

It is especially important that clear cutting of young second growth just as it begins to reach a size which may be converted into usable products should be stopped. Such stands will generally make their best contribution if allowed to attain larger size, and a growing stock sufficient to meet prospective needs for all classes of timber cannot be attained if these young stands are generally cut off. Through various silvicultural operations it would be possible to increase the proportion of fast-growing or otherwise desirable species and more nearly to maintain that density of stand which is most favorable to rapid growth of usable timber.

While the application of these measures involves many silvicultural and economic factors concerning which much remains to be known, present knowledge is adequate for progressive improvements. Further knowledge can be gained only through a long-time program of research in silviculture, forest products utilization, forest economics, and related fields such as entomology, pathology, and plant and animal ecology.

HOW MEETING OF PULPWOOD REQUIREMENTS WOULD AID IN CONSERVATION PROGRAM

The situation has been discussed in general terms because the pulpwood situation is an integral and inseparable element of the whole national forestry problem and because replacement of imports of pulp and paper by domestic production might vitiate a sound conservation program if national requirements for all other forest products were not also being satisfied. On the other hand, building up and extending the pulp industry in all sections of the country offering satisfactory operating and marketing opportunities, might prove a decided

stimulus to proper forest management, might constitute an important means of maintaining permanent forest industries, especially in regions where growing stocks have been seriously depleted, and might assist in the amelioration of agricultural conditions by affording a reasonably stable source of cash income from farm woodlands and providing many opportunities for employment on a part-time basis. The contributions to employment thus made might, of course, be offset in whole or in part by corresponding reductions in employment in export industries should their volume of business be adversely affected by reduction of pulp and paper imports.

The application of intensive forestry that would be necessary over a considerable portion of the commercial forest area under an adequate national program, would involve wide-spread use of cultural measures to increase the quantity and quality of the growth. The more important of such cultural measures would be thinnings in thrifty second growth and improvement cuttings in the depleted and deteriorated stands which are especially prevalent in the older regions. That portion of the total prospective yield represented by the products of thinnings and improvement cuttings, being generally unsuited for manufacture into lumber, can only be turned to account through outlets such as are provided by the pulp industry. Increasing the amount of material utilized in this way might be undertaken at once without prejudice to the need for restricting the total cut in the eastern regions in order to build up deficiencies in existing growing stocks. In fact, this is one of the most practical ways in which the difficulties resulting from unrestricted cutting in the past may be overcome.

But it must be emphasized that pulp enterprises, while holding great prospects for assisting in the realization of a sound forestry program, might invite disaster if allowed to develop without control. Industries capable of using trees of small size generally follow in the wake of lumbering, "cleaning up" small blocks of timber which may be left, and stripping off second growth just as fast as it reaches a size suitable for any commercial product. When first established, such industries usually find an abundant supply of second-growth timber available locally at low cost. But unrestricted clear cutting of these sources of supply invariably results in stripping of the adjacent territory, followed by progressively increasing costs of wood as it becomes necessary to go farther and farther away. Under these conditions smaller industries tend to be transient, but industries requiring a large permanent investment, of which the pulp industry is most important, cannot move and soon find themselves at a serious disadvantage in a competitive market. In the older regions this process has resulted in a cumulative depletion of growing stocks which has seriously disrupted markets for forest products, reduced the saw-timber industry to a bare shadow of its former importance, left many formerly prosperous communities without any industry at all, and forced other communities to turn to other sources of support. Clearly the pulp and paper industry would do well to place its operations on a sustained-yield basis and to encourage landowners from whom they may purchase wood to cooperate in maintaining proper growth conditions in the region tributary to their mills. Several pulp and paper companies have recognized this situation and have gone far in applying sound forestry practices in the management of their forest properties.

The pulp industry might also contribute substantially to the achievement of an adequate program of forestry through its ability to eliminate waste by the utilization of material in saw-timber stands unsuited for the manufacture of lumber. In saw-timber operations there is always a considerable volume of such materials. It consists of trees which are too small for saw-timber and yet not offering promise of satisfactory future growth, trees of inferior species not marketable for lumber under conditions which may exist in any particular locality, such as white fir in the Pacific coast region, tops and limbs of saw-timber trees, and portions of trees otherwise left in the woods on account of defect or breakage. In the sawmills, also, large quantities of material must be thrown aside as unsuited for the manufacture of lumber. Profitable utilization of this material often constitutes a problem which might be effectively met by the pulp industry.

In fact, integration of the lumber and pulp industries, a highly desirable objective in working out a national program of forestry adequate to supply all timber needs for the future, would appear to be fundamental to consideration of the possibilities of national self-sufficiency in respect to pulpwood requirements.

ADVANTAGE OF INTEGRATION OF FOREST INDUSTRIES

To an increasing extent it should therefore prove desirable to obtain the raw materials for wood-pulp mills as byproducts of the management of forests for saw timber. Not only would material be generally available from cultural operations, from salvage of dead trees, and from logging and milling wastes, but when operations are properly correlated, material so obtained should prove relatively cheap to the pulp mills and its utilization will be helpful to the sawmill industry and beneficial to the forest. Integration of this sort has been of increasing importance in the northern European countries and doubtless is a significant factor in the ability of their industry to compete in our market.

Integration of pulp and lumber industries also permits of economies in operating practices by converting into lumber only those logs or portions of logs which can be marketed at a profit and diverting to the pulp mill material that is very commonly converted into lumber at a loss. Analysis of production costs in several sections of the country has conclusively shown that profits from the manufacture of lumber are increased to the extent that operations are restricted to the larger-sized material. Where pulp mills are operated in conjunction or in cooperation with sawmills, the margin of material profitably converted into lumber may be varied upward or downward with current market conditions, thus maintaining efficient operation without modification of desirable close utilization practices in the woods.

PULP AND PAPER INDUSTRY CANNOT BE DEPENDENT UPON LUMBER INDUSTRY

Because the lumber industry has always been a much larger consumer of stumpage than the pulp industry, and because trees must be grown to larger size for saw timber than for pulpwood, foresters

approaching this problem from the standpoint of the forest are prone to consider that the pulp industry will be subordinate to the lumber industry. But because of the larger plant investments which they require, the paper and pulp industry cannot afford to be dependent on any other industry for its raw material. Furthermore, in looking toward the future, there is a reasonable prospect that the pulp and paper industry will continue to grow at a rapid rate and extend into almost every section of the country, whereas consumption of lumber has been on the decline since 1909. If the United States should approach self-sufficiency in pulpwood requirements, the total value of the primary product of the pulp mills would probably approximate the value of the products of the lumber industry, while the value of paper and boards, the secondary products, might easily be more than double the future value of lumber products. Capital assets of the pulp and paper industry in this country are already comparable in magnitude to those of the lumber industry.

It is not unlikely, therefore, that the pulp industry will assume a coordinate if not dominant position in the newer regions in the future, very much as it has in the spruce-hardwood region of the Northeast in the past, and this makes it important to view the question of integration of raw material supplies for pulp and lumber industries from a different angle. But the considerations which have been discussed in the previous paragraphs are fundamental to the solution of the forestry situation of the country and would not lose their significance should the pulp industry assume larger importance.

PULP INDUSTRY MAY REDUCE WOOD COSTS BY SALE OF SAW LOGS

To the extent that forests are placed on sustained yield management for the production of saw timber, large quantities of pulpwood will be available as a byproduct. This should keep the price of pulpwood permanently on a relatively low plane and make it increasingly difficult for forests organized primarily for pulpwood to compete. Wood produced in such forests would have to stand all costs of growing the timber whereas in the first case a major part, if not all, of the forestry costs might be borne by the saw timber, leaving pulpwood stumpage in very advantageous position.

It would therefore appear that in many cases, even when the land is owned by pulp and paper companies, it will be advantageous to manage the forests under rotations suitable for saw timber, with the expectation that the sale of saw-timber stumpage will serve to reduce the cost of pulpwood to the mills. Under these conditions, organization of forests solely for pulpwood production would have a place only where no market for saw logs may be anticipated, where logging for saw timber is physically out of the question, or where the prospective cost of pulpwood produced as a byproduct of saw-timber management would not be lower than the full costs of forestry on the shorter rotations contemplated for pulpwood. Even in these cases, as has previously been pointed out, it may be desirable to organize the forest for pulpwood production, not on a short rotation with clear cutting, but on a fairly long rotation with selective or partial cuttings at relatively frequent intervals.

PACIFIC COAST POINTS WAY FOR SOUTH AND NORTHEAST

The development of the pulp industry on the West Coast has led the way in indicating the possibilities of integrating pulp production with lumber manufacture. The opportunities are particularly large there because of the tremendous amount of timber which must otherwise be left in the forest as unsuited to the manufacture of lumber under current economic conditions and logging and milling methods. But possibilities for integration may be developed in all regions and are especially to be encouraged in connection with the exploitation of second-growth timber in the South. Here the conditions for the production of saw timber are particularly favorable, and maximum production of this class of timber seems reasonably certain to be in demand in the not distant future. Under desirable standards of manufacture, perhaps 25 percent of the total yield of second-growth forests will not be suitable for lumber. This portion of the growth should not be wasted but should be utilized for other purposes, among which pulp holds perhaps the largest possibilities.

Integration of industry will also be of increasing importance in the northern regions as the hardwood species are more widely used for pulp. Hardwood lumber has generally sold at higher prices than softwoods, but unsatisfactory markets for hardwood stumpage have been in large measure due to the fact that operating costs were high because such a small percentage of the gross volume in the woods was suitable for saw timber. Operating conditions would be much improved and forest values greatly enhanced if utilization for pulp would permit removing larger total quantities per acre.

It is believed that increased stability would be gained by both the lumber and pulp industries and that the objectives of meeting national timber requirements would be best served through widespread integration of the industries either under unified management or, perhaps preferably, through the establishment of active log or pulp-wood markets in each region following the precedent which has been established on the Pacific coast.

SUMMARY OF FORESTRY SITUATION

To sum up, it appears that the available forest-land area of the United States would be adequate to meet normal timber requirements for all purposes if properly managed, but that scientific husbandry to maintain production values in the West, to build up available growing stocks in the East, and to restore to productivity lands now idle or denuded, would call for the best effort the Nation can put forth. Viewed solely from its conservation aspects, production of the pulp-wood required to supply the Nation's need for paper and pulp, should fit admirably into such a forestry program, utilizing material which might otherwise go to waste on a large scale and making possible the stimulation of growth and creation of optimum growth conditions for valuable saw timber by cultural operations in young stands. The production of raw material for the pulp and paper industry might well be integrated to a large extent with the production of high-quality saw timber.

SOCIAL AND ECONOMIC ASPECTS

BENEFITS OF INDEPENDENCE IN PULPWOOD SUPPLIES

It has been shown that a paper and pulp industry capable of meeting possible future requirements would be entirely compatible with the productive capacities of our forest, and, in fact, the steady demand of such an industry for raw materials would not only serve to stimulate proper management of forest lands, but also, if properly controlled, to facilitate the attainment of sustained-yield objectives for all forest products. Beyond this there are a number of ways in which economic and social benefits might accrue to this country if paper and pulp requirements were produced at home. Considering the welfare of the Nation as a whole, these benefits might be offset in whole or in part by adverse effects on agriculture and export industries which might result from curtailment of pulp and paper imports. These related considerations concerning foreign trade are discussed in a later section.

ECONOMIC UTILIZATION OF LAND

Possibly the most significant of possible benefits from expansion of the domestic pulp and paper industry is the economic utilization of a considerable part of the land area unsuited for agriculture. Disregarding for the moment the concurrent needs of other industries the production of the possible future pulpwood requirement of 25 million cords under present average growth conditions would call for the exclusive utilization of over 100 million acres of forest land. This figure might be reduced to about 50 million acres under reasonably intensive forest management. But it is not likely that pulpwood requirements will be obtained entirely from forests organized solely for pulp production. If from forests organized to supply both the pulp and lumber industries with raw material only 25 percent of the total yield is converted into pulp as previously suggested, a much larger area would be involved. All things considered, it would seem that satisfaction of prospective pulp and paper requirements would contribute to the effective utilization of from 100 to 200 million acres of forest land.

OPPORTUNITIES FOR DIRECT EMPLOYMENT

Another important economic and social consideration is the opportunity for direct employment which this industry would provide. In 1929 the wage values represented in our imports of foreign pulps, pulpwood, and paper were equivalent to full-time employment for about 70,000 workers, or nearly half as many as were actually employed in the entire domestic industry. If the output per man in the production of pulp and paper should remain the same as reported in the census of 1929, and if woods labor be estimated at 300 cords per man per year, an industry capable of producing a possible future requirement of 24 million tons of paper would provide full-time employment for about 385,000 men, or 243,000 more than were employed in 1929. This might be increased by a few thousand persons to

provide for the technical and administrative force and labor involved in growing the timber crop in forests organized for sustained yield. The salaries and wages which this potential industry would pay at the rates which applied in 1929 would be at least \$588,000,000 annually, or an increase of about \$372,000,000 over the amounts paid in 1929. At 1929 rates the value of the products of this prospective industry would exceed 2 billion dollars each year.

The increased direct employment which self-sufficiency in pulp and paper would provide might represent a transfer of employment from export industries because cessation of pulp and paper imports might involve corresponding decreases in the production for export of such products as cotton, wheat, automobiles, etc. The offsetting wage value of our export trade affected by pulp and paper imports, being indirect and diffuse, cannot be definitely estimated.

STABILITY OF COMMUNITIES

The additional direct employment and the volume of other business which self-sufficiency in the paper and pulp industries would entail would be spread over many sections of the country. It would be particularly valuable in the development of stable and permanent communities in the South and far West, where substantial industrial development is especially desirable for both social and economic reasons. If planned in relation to sustained yield capacities of adjacent forests, this expanded industry should lend much stability to the communities involved at the same time that it is stimulating their growth. This would be of importance in the planning for schools, roads, water supplies, and other matters with which local government is concerned.

The stability of industry and communities which the pulp and paper industry might assure, if wisely planned, would be in part a result of the relatively large plant investment required by the industry. Under present conditions approximately \$30,000 capital investment is required per ton of daily paper capacity. An increase in paper mill capacity which might amount to 10,000,000 tons a year would involve an investment of almost \$1,000,000,000 and in addition self-sufficiency would require \$84,000,000 of new capital to bring pulp production up to the full capacity of existing paper mills. Capital investments and pay rolls of the order indicated would have very substantial effects in creating additional taxable values in the communities involved.

AID TO AGRICULTURE

But these possible benefits from a larger domestic paper and pulp industry would perhaps be of more significance to agriculture and rural population than to any other elements in our economic structure.

The most direct benefit to the farmers would be in the market which established pulp industries provide for products of the farm woodlands. Pulpwood is a product which an ordinary farmer can make without any appreciable investment in special equipment, and without dependence on outside help. Moreover, as a general rule, the cutting and hauling of pulpwood can be done at times when the demands of other activities are slack. The opportunity of the farmer

to sell pulpwood each year at almost any season provides a very desirable and generally much needed source of cash income to carry him through the months required to mature his crop, and may often give him a measure of independence which he might not otherwise claim.

In addition to the market for wood, stable industries, with their dependent communities, provide for the farmers a local market for agricultural products, especially truck crops, and dairy and poultry products. This would make possible a diversification which lends stability to agriculture, especially where major dependence is on crops for distant markets.

A third aspect of the possible benefit to agriculture from building up the domestic pulp and paper industry would lie in the farmer's share of the employment opportunities. The social and economic advantages of rural industrial communities, in which part-time employment for local agricultural population is afforded by industry, have received wide-spread recognition in recent years. Where paper and pulp mills are established a certain portion of the rural population, especially those not having land of their own, may obtain seasonal work in the woods or mills or part-time occupation for teams and trucks in supplying the mills with raw materials.

All these factors would tend to raise the margin of profitable agriculture and to raise the standard of living in rural sections. Profitable farms might be maintained on land which, without local industries, would be submarginal for agriculture. The benefits of improved roads, railroad connections, stores, hospitals, educational, and recreational facilities, etc., in such regions might be obtained on a plan which could not be supported by agriculture alone, and, in addition, the development of rural industries might tend to reduce the farmers' share of local tax burdens.

These mutually beneficial interrelations between agriculture and the pulp and paper industry have been demonstrated in parts of the older pulp producing regions, especially in northern New England, and the need for development of this sort appears to be rather widespread in the new regions.

REGIONAL COMPETITION

But the possible development of the pulp and paper industry in the South and other new regions would involve the working out of a number of important economic problems not the least of which would concern the character of competition between the several producing regions in this country.

In considering regional competition a distinction must be made between pulp and paper mills. In the first, the raw material, usually wood, is converted into pulp, which thereupon becomes the raw material for the second. In other words, the complete transition from wood to paper involves two distinct conversion operations, which need not be carried on at the same place. This situation has led to the differentiation of paper mills into two broad classes, the so-called "self-contained" mills and the "converting" mills. The former manufacture both pulp and paper. The latter purchase pulp for paper making.

Self-contained mills tend to locate near their raw-material source and to effect economies through merging of the pulping and paper-making operations. This advantage is frequently offset by increased freight charges on finished paper. The converting mills are usually located near consuming markets. Freight costs on pulp are offset by short and cheap transportation to the customer.

Newsprint and certain other types of mills involving large tonnage are generally of the self-contained type. In the converting class, board mills are about the only large-tonnage group, but most of the small specialty mills fall into this class also.

In a brisk pulp market with good demand and high prices, the self-contained mill, producing its own pulp, holds the advantage. In a buyers' market, with slack demand and low pulp prices, the converting mill is better situated, obtaining its pulp often at less than cost and not being burdened with a large pulp-mill investment.

The most significant factor in regional competition is cost, which involves three principal elements, namely, raw material, conversion, and transportation to market. Costs of conversion from pulp to paper show little significant variation. Such advantages as one mill may possess over another lie in more modern machines and efficient operation—in factors of management, initiative, and competence not dependent upon outside conditions. The substantial differences in costs more often depend upon the raw materials and the transportation expenditures. In the ultimate analysis these items are integral with the pulpwood and pulp costs.

Considering only wood pulp, the factors of wood and transportation are again most significant. Here, as with paper, conversion costs tend to level out, advantages of one locality over another being offset by disadvantages which have a neutralizing effect. The matter, therefore, reduces itself to the price of wood and its distance from the ultimate markets.

As evidence of this conclusion may be presented the pulp-cost figures for regions compiled by the Timber Conservation Board in 1931, and shown in tables 14 and 15. Although these figures are not up to date, it is believed that the relations shown remain essentially unchanged. These data show the relatively wide spread between wood costs in the several regions, in contrast with a comparatively small spread in mill conversion and expense outlays. In table 15 the balance of regional costs and transportation charges in common markets show advantages which these lower wood costs yield to certain areas, largely the West and South, which are able to compete successfully in spite of distance and freight cost. Table 15, based on wrapping-paper freight costs but indicative of the situation as to pulp and paper in general, likewise brings out the relative advantage enjoyed by mills on tidewater in relation to the large markets of the eastern seaboard.

TABLE 14.—*Weighted average wood-pulp costs by principal kinds of pulp, by major cost divisions and by regions as of June 1931*

[Dollars per ton of wood pulp]

Kind of pulp and region	Costs						
	Total	Wood		Mill conversion		Other expense	
		Dollars	Percent of total	Dollars	Percent of total	Dollars	Percent of total
Mechanical:							
United States average.....	\$25.66	\$14.80	58	\$8.26	32	\$2.60	10
New England.....	25.34	14.78	58	8.67	34	1.89	8
Middle Atlantic States.....	28.55	19.04	66	6.81	24	2.70	10
Lake States.....	28.37	15.44	54	9.72	34	3.20	12
West.....	21.55	9.12	42	9.84	46	2.59	12
Unbleached sulphite:							
United States average.....	41.33	24.78	60	13.27	32	3.26	8
New England.....	45.35	27.69	61	14.50	32	3.15	7
Middle Atlantic States.....	47.80	32.82	69	11.93	25	3.04	6
Lake States.....	42.27	23.75	56	14.23	34	4.28	10
West.....	30.31	14.65	48	13.25	44	2.40	8
Sulphate:							
United States average.....	31.84	12.08	38	14.47	45	5.29	17
Lake States.....	40.57	18.05	45	17.63	43	4.87	12
South.....	25.64	8.63	33	12.29	48	4.72	19
West.....	21.67						

TABLE 15.—*Balance of regional pulp costs and transportation charges in common markets, 1931*

[Costs in dollars per ton]

Class of pulp and source	Cost at mill	Destination				
		New York			Chicago	
		Transportation		Delivered price	Railroad transportation rate	Delivered price
		Kind	Rate			
Mechanical pulp:						
New England.....	\$25.34	Rail.....	\$5.50	\$30.84	\$9.00	\$34.34
Middle Atlantic.....	28.55	do.....	5.25	33.80	7.75	36.30
Lake.....	28.37	do.....	11.50	39.87	3.80	32.17
Pacific coast.....	21.55	do.....	26.00	47.55	20.00	41.55
Pacific coast.....		Water.....	7.50	29.05		
Unbleached sulphite:						
New England.....	45.35	Rail.....	5.50	50.85	9.00	54.35
Middle Atlantic.....	47.80	do.....	5.25	53.05	7.75	55.55
Lake.....	42.27	do.....	11.50	53.77	3.80	46.07
Pacific coast.....	30.31	do.....	26.00	56.31	20.00	50.31
Pacific coast.....		Water.....	7.50	37.81		
Sulphate:						
Lake.....	40.57	Rail.....	11.50	52.07	3.80	44.37
South.....	25.64	do.....	13.25	38.89	9.40	35.04
Pacific coast.....	21.67	do.....	4.60	30.24		
Pacific coast.....		Rail.....	26.00	47.67	20.00	41.67
Pacific coast.....		Water.....	7.50	29.17		

¹ Rate quoted February 1935.

It appears that tidewater mills on the Pacific coast may compete successfully in the New York market in any of the principal classes of pulp. In the Chicago market the lake region enjoys an advantage in respect to mechanical and sulphite pulps—but sulphate pulp from the South may apparently enter this market without serious inter-regional competition. This indicates that, should mechanical and sulphite production be established in the South, that region might control prices for these products in the Chicago market just as effectively as is now the case with sulphate pulp.

It is believed that the spread in wood costs will tend to decrease as new regions supply increasingly large quantities of pulpwood. In the first place, production in the new regions will lessen the pressure for stumpage in the older regions, and consequently lower prices will prevail there. In the second place, extremely low costs which often characterize early developments in new sections may be expected to rise gradually to approach wood costs in the older regions and to reflect more fully the actual growing costs. No such tendencies are as yet evident, however, as depression influences have had little or no selective action, and wood prices have been depressed alike in all regions; if there has been any differential, it has tended to emphasize the lower prices in the South and West, where quality differences or diminished demands for lumber have had a marked effect.

It should be pointed out that elimination of spread in wood costs does not mean the same local price everywhere. The wood price in remote areas must remain consistently lower in order that the freight disadvantages may be offset. The relatively high prices which have been paid for wood in the Northeast, for example, are not to be anticipated in planning new developments in more remote regions.

One other factor, applying with equal force to both pulp and paper production costs, is ratio of plant capacity to actual operation. Both paper and pulp mills are designed for continuous production, and fixed charges—which are large—tend to wax or wane as the production falls below capacity or is maintained full scale. In recent years the mill organization has been fortunate which could operate on as much as 80 percent of rated capacity, and costs have reflected the subnormal activity of the industry. In comparing current costs of mills with prospective costs in new installations it should be kept fully in mind that the former do not represent the most favorable conditions and that lower gross figures might be anticipated if all tonnage capacity were utilized. Conversely, if proposed units fail to obtain adequate business to permit capacity operation, a corresponding increase in production costs will result, frequently tending to dim the prospects of profit which first estimates promised.

RECOMMENDATIONS FOR FOREST CONSERVATION

It has been shown that the equivalent of more than 50 percent of the Nation's current pulpwood requirement is imported in the form of either wood, pulp, or paper, and that the upward trend in consumption of pulp and paper in the United States, interrupted by the depression of recent years, may probably be expected to reassert itself, although perhaps at a somewhat slower rate. Evidence has been given to show that the forests of the United States, if intelligently managed for sustained yield, could supply without dependence upon

imports not only present and prospective pulpwood needs but also requirements for other forest products. Reasons have also been cited to show how making the United States self-supporting as to pulpwood, pulp, and paper requirements would advance a national program of forest conservation and contribute substantial economic and social benefits, which, however, might be offset by reactions in foreign trade.

But ability of domestic forests to meet pulpwood requirements is contingent in large measure on the wider use of species other than spruce and fir, which have until recently dominated the pulp and paper industry. For this reason development of the pulp and paper industry to make this country self-supporting would have to take place to a large extent in the South and the Pacific Northwest, and to a lesser extent in Alaska.

Expansion of the domestic industry should be guided by considerations of economic and social benefits and should be planned in relation to an assured and permanent supply of low-cost raw material, which implies wide-spread and consistent application of sound forestry principles. The problems involved and the interests at stake are such as to require the best efforts of both the industries concerned and the public. Progress toward self-sufficiency in respect to pulp and paper requirements would best be promoted by action aimed at providing favorable conditions and greater incentive for sustained yield forest management. In matters of this sort the interests of all wood-using industries would be served equally and indeed the problem of supply of raw material for the pulp and paper industry is so closely interrelated with requirements for other wood-using industries, that they may well be considered together.

For these reasons the recommendations for a program of forest conservation which follow are more or less general in character, deal with the pulpwood situation as an integral and inseparable part of the larger problem of forestry and conservation for the Nation, and are in conformity with those of the Copeland Report.

PUBLIC ACTION

RESEARCH

One of the most important phases of necessary Federal action with respect to the pulp and paper situation is the prosecution of research in all phases of forest management and wood utilization. Thorough knowledge of the growth and silvical requirements of the many important forest-tree species of the country and of their response to cultural treatment is essential to successful forest management. That existing information is far from adequate is evidenced by the problems which are arising in the efforts of the forest industries to work out adequate rules of forest practice under their respective codes, and by similar problems encountered in the operations of the Civilian Conservation Corps, where, for the first time in this country, large numbers of men have been made available for cultural operations in the forests.

Research in wood utilization, of basic significance in all forest industries, is especially important to the paper and pulp industry because the successful operation of this industry is so thoroughly

dependent upon the technical processes involved. Some indication of the fields in which research is contributing toward the solution of the problems of the pulp and paper industry has been given in another section of this report. It is only through research that the industry may learn to use a wider variety of species for exacting paper requirements, to obtain higher yields of pulp from a given quantity of wood, and to make better paper at lower cost.

PUBLIC OWNERSHIP OF FOREST LAND

The general failure of private ownership to maintain the forests in productive condition and to conserve the several public values inherent in this resource has led to conditions which make desirable, if not essential, a large-scale program of public acquisition. Such a program was outlined and discussed in detail in the Copeland Report and has been initiated by President Roosevelt as part of the emergency conservation work. This program, which may eventually involve the acquisition of more than 200 million acres, chiefly in the East, should serve to stabilize land ownership throughout the country and should aid very substantially in attaining the desired objectives of sustained-yield management. It will relieve industry of some of the more difficult situations and should stimulate effective management under private ownership in the more favorable situations.

ADEQUATE PROTECTION AND EQUITABLE TAXATION

Effective cooperation of private forest landowners and of forest industries in the proper management of forests, which is a prerequisite for national self-sufficiency in pulp and paper, should be stimulated and encouraged by aid from the public through the Federal Government and the States in adequate protection of the forests from fire, insects, and disease, and in equitable taxation adjusted to the character of the income which the forests may produce. These matters are discussed in considerable detail in the Copeland Report and elsewhere, but they are mentioned here to reemphasize their vital relationship to the problem of providing for the Nation's pulpwood supplies.

EXTENSION OF KNOWLEDGE OF FOREST MANAGEMENT

The cooperation and independent action on the part of timberland owners and operators should be further encouraged and aided by a country-wide campaign of education. The present program of public education through the farm-extension service is altogether inadequate to meet the problem. What forestry measures are necessary, how operations should be organized to conform to conservation regulations and to keep costs at a minimum, and how products may be marketed to best advantage are matters in which the thousands of timberland owners and operators throughout the country need instruction and aid.

CONTROL OF TIMBER-CUTTING OPERATIONS

Since the problem of supply of wood for paper and pulp is so closely interrelated with the problem of providing raw material for all wood-using industries, and since, in relation to the national needs, so little

progress in conserving the productive capacity of the forests has been made through individual initiative, it becomes a matter of basic importance that some form of Nation-wide control be exercised over timber-cutting operations. Cooperative industrial control to insure handling of timber-cutting operations in accordance with established forestry principles was contemplated in the application of the conservation articles of the codes of the forest industries, which were inaugurated under the National Industrial Recovery Act. Action on the code for the pulpwood industry did not reach a point where it is possible to judge how satisfactory progress might be through such cooperative control, and experience under the lumber code was far from conclusive.

Because of the large capital investments which the pulp and paper industry requires and the need for an assured and stable supply of raw material at reasonable cost, self-interest may be expected to encourage ownership and organization of forests for sustained yield by the pulp and paper industry to a larger extent than may be the case with other wood-using industries. But even in this industry voluntary effort to provide for proper treatment of forests tributary to existing mills is in evidence in relatively few instances. Current economic conditions, while offering unusual opportunities for the accumulation of desirable timberland holdings at relatively low cost, seem to hold promise of maximum present profit through the purchase of wood from farmers and others who are seeking to liquidate their timber to obtain cash income to meet their daily needs. Under such conditions some form of public control would probably be necessary to check the indiscriminate clear cutting of immature timber which has so characteristically followed the exhaustion of virgin stands in every forest region, and to assure a sustained annual yield commensurate with possible future requirements of the Nation for pulpwood, lumber, and other forest products.

Control over cutting operations might be effected either through codes for the forest industries such as were inaugurated under the National Industrial Recovery Act, or by other cooperative measures involving State or Federal initiative and control. Since the problem is essentially concerned with proper handling of all forest lands rather than with the methods of operation of any particular industry depending on the forest for its raw material, it seems logical and desirable that the necessary measures of control be incorporated in basic legislation applicable to all forest industries.

ACTION BY INDUSTRY

Upon the paper and pulp industry rests responsibility for aggressive and intelligent effort to keep abreast of the growing demand for paper and pulp and to control and perfect manufacturing practices so that the domestic products may successfully compete in quality and price with those produced in other countries.

The degree to which the forest industries undertake to adapt their practices to the principles of sound forest management will determine in large measure the necessity for the exercise of public control of timber cutting operations. The interest of the pulp industry would be well served by measures looking toward sustained yield management of all forests supplying it with wood, and every effort should be

made to integrate the needs of all wood-using industries in a given territory.

Much progress could be made by plans for the organization of forest lands supplying existing pulp mills, but stability for the future can best be insured by foresight and wise planning of new units. The forests of the country are not in condition to support new mills established without respect to sustained yield management. Indiscriminate installations in an unguided effort to become independent as to pulpwood requirements may do more harm than good in the long run. But new developments should not be obstructed when proper provision has been made for a permanent supply of raw material under an appropriate program of forestry.

RELATED CONSIDERATIONS CONCERNING FOREIGN TRADE

As stipulated in the Senate resolution, the body of this report has been concerned with the feasibility and characteristics of a national program of forest conservation to make the United States self-supporting as to paper and pulp. But some questions outside the field of forest conservation should also be considered.

Realization of a program of self-sufficiency, even in present pulp and paper requirements, would involve far-reaching economic considerations, because it would imply displacement of important items of import trade which might affect export trade adversely. Such a program might seem to be out of harmony with the current efforts of the Government to restore international trade. It is therefore essential briefly to review certain aspects of the situation and to indicate the relation of the program to other Government policies.

UNITED STATES NOW A CREDITOR NATION

Prior to the World War the United States had developed as a pioneer country indebted to the older countries of Europe for much of the capital needed for its rapid growth. Under these conditions a foreign trade was built up in which an excess of exports over imports was necessary to carry interest charges and pay off indebtedness. But the United States emerged from the World War a creditor nation with practically every important country indebted to it. The net credit of the United States abroad was in excess of 14 billion dollars, as compared to a net debt of 2.7 billion dollars before the war.

To maintain healthy foreign trade under these changed conditions, national policy should have sought to increase the proportion of imports to exports. But with both industry and agriculture equipped to produce large quantities of goods for export, foreign trade was continued for a decade on much the same basis as before the war. In the face of increased tariffs, huge loans to foreign countries, and greatly increased expenditures of tourists abroad were the chief means of financing the excess of our exports over imports and getting some payments on foreign indebtedness.

With the cessation of American loans abroad in 1929, foreign countries no longer had the purchasing power to continue to take our exports on such a large scale and by 1933 the value of American foreign trade was less than one-third of what it was in 1929. Rapidly

mounting and tightening trade barriers both here and abroad helped to accentuate the situation.

That our exports have declined more drastically than world trade in general is indicated by the fact that whereas the United States sold more than 15 percent of the world's exports in the decade following the war, its share of the world's export business in 1933 was reduced to less than 11 percent.

Furthermore, American agriculture has been more seriously affected than American industry, its share of our export trade dropping from 50 percent or more prior to the war to about 35 percent of the total in 1934. But agricultural production does not contract readily in proportion to loss of markets as is the case with industry and as a result farm prices fell to much lower levels. Agricultural production in 1934 was only 15 percent under that of 1929 but agricultural prices were down 40 percent for the same period. For industry the figures can be reversed—production in 1934 being 40 percent below that of 1929 while prices of industrial products were only 15 percent lower.

INCREASED IMPORTS SOUGHT TO SUSTAIN EXPORT TRADE

In the hope of readjusting this situation national policy has recently been directed toward curtailment of production in agriculture and stimulation of foreign trade by attempts to reduce trade barriers here and abroad. Building up purchasing power for our products abroad by enlargement of existing imports should prove beneficial to both agriculture and industry. But foreign purchasing power does not depend solely on the volume of imports. It is directly influenced by adjustments in the value of money both in this country and abroad. It will be increased by larger expenditures of American tourists abroad or remittances of immigrants to their home countries. These items were of major importance before the depression and have been at low levels in recent years. They would be likely to assume larger proportions again as confidence is restored and recovery progresses. Even with these items at predepression levels, however, our exports were maintained only by heavy foreign loans.

American agricultural production has traditionally been far in excess of domestic consumption and prior to the World War the surplus was an important means of meeting our obligations abroad. But now with credit balances reversed disposal of the agricultural surplus depends more directly on the amount of imports which can be brought into this country. Unless and until imports can be increased agricultural production must be adjusted more closely to domestic needs.

Export markets are also needed fully to utilize the industrial plant capacity of this country. Stimulation of agricultural export trade would contribute indirectly to increased industrial activity because it would raise the purchasing power of the farmers. But here also most direct and permanent stimulation to trade would accrue from increased imports. As a direct corollary any policy, such as self-sufficiency in pulp and paper, which would displace existing imports or prevent their expansion, might mean a commensurate loss of business and opportunity for employment in agriculture or industries now dependent upon export trade. For international trade is in the nature of an exchange of labor as well as of goods.

In its effort to stimulate foreign trade the Government is now negotiating trade agreements with foreign countries. Secretary Wallace has pointed out ¹ that in such tariff bargaining foreign countries can be induced to take our exports in larger volume only by concessions which will permit them to sell more of their goods in this country.

No concessions are possible on noncompetitive goods such as coffee, tea, or rubber, on which no duties are levied, except by "binding" them on the free list. Real concessions must come by removing hindrances or restrictions which now exist. But concessions should be made where they will work the least hardship and where there is no risk of permanent economic sacrifice. Tariff barriers may perhaps be lowered on a large list of dutiable articles, imports of which represent only a small proportion of domestic production. In this group Secretary Wallace has said that concession should be made first on articles produced under monopoly or on those whose consumption normally responds to a lowering of price, that concessions should also be made on those commodities with the highest ad valorem rates, and that rates exceeding 50 percent ad valorem indicate ineffective domestic production. According to the Secretary, the policy of the administration may be regarded as favoring those industries in which productive capacities are most effective. He holds that as a general rule comparison of wages paid by competing countries is of little value because output per man is usually greater where wages are high and industries paying highest wages are among those most able to meet foreign competition without protection.

READJUSTMENT OF AGRICULTURE WILL HELP

Significant as these trade negotiations may be, current world conditions offer no immediate prospect of restoring agricultural exports to their former volume. As far as can be seen now the United States must think in terms of curtailed foreign outlets for its agricultural products, and that this means continued adjustment of acreage devoted to agricultural crops, with expansion only as domestic and foreign markets expand.

Adverse conditions during recent years have focused attention on numerous maladjustments in land use throughout the country. It is generally conceded that agriculture has been extended into many areas, where soil, climate or other factors are not suited to economic production. Other areas formerly productive, have been rendered unprofitable for further cultivation by soil erosion, changes in type of farming or other factors. If appropriate adjustments could be made between and within regions both as to type of farming, and as to areas devoted to specific crops or uses, at least some of the difficulties of excess agricultural production might be solved.

One of these adjustments requires the use of considerable areas of submarginal lands for timber growing. Economic use of such areas will require the maintenance and development of industries, such as pulp and paper manufacture, which would furnish markets for the products of the land.

¹ The Reopening of Foreign Markets for our Agricultural Products, address by Henry A. Wallace at the American Institute of Cooperation, Madison, Wis., July 11, 1934.

Such an adjustment may be illustrated by cotton, about two-thirds of which has been exported in the past. While it appears that the volume of cotton exports depends mostly on foreign purchasing power which may be influenced by imports into the United States, cotton is subject to increasingly severe foreign competition in physical production which is not so influenced. Difficulties in marketing this crop might, therefore, be relieved in part by diverting to timber growing lands found to be submarginal for cotton. At the same time the forest industries which might be developed would be of substantial benefit to the farmer on the better lands.

A second possible adjustment is the use for range and livestock production of land now devoted to wheat raising in dry sections. The wheat surplus constitutes one of our most critical agricultural problems, whereas imports of animal products (not including dairy, poultry, fish, furs, and manufactures) have for some time exceeded or nearly equalled exports. While trade barriers are an important factor in restricting exports of wheat from the United States, recovery of foreign markets will be made more difficult by increasingly severe foreign competition which is not influenced by American imports. Reduction of acreage in this crop and reseeding the land for range use, would not only help the wheat market situation but might serve to reduce the evil of dust storms and soil erosion.

The study of the whole question of agricultural adjustments is in a preliminary stage and much more must be done to work out permanent and satisfactory solutions.

THE PLACE OF PULP AND PAPER IN FOREIGN TRADE OF THE UNITED STATES

Pulpwood, pulp, and paper are unique among wood products in respect to foreign trade. Whereas lumber and wood manufactures are exported in considerable quantities and imports of most items are of relatively small proportions, imports of pulpwood, pulp, and paper had a value of \$140,208,000 in 1933. They are again on the increase after declining from a peak of \$267,050,000 in 1929. But as indicated in table 16, imports of pulpwood, wood pulp, and paper constituted only 6 percent in 1929 and 10 percent in 1933 of all imports of this country. Prior to 1933 they represented less than 20 percent of the value of agricultural exports.

TABLE 16.—*Foreign trade of the United States*

	1929	1933
Exports:		
Total, all commodities.....	\$5, 157, 000	\$1, 647, 000
Agricultural total.....	1, 693, 000	694, 000
Cotton.....	765, 000	395, 000
Imports:		
Total, all commodities.....	4, 339, 000	1, 433, 000
Agricultural total.....	2, 218, 000	743, 000
Paper, wood pulp, and pulpwood.....	267, 000	140, 000

This group of products does not offer much opportunity in negotiating trade agreements to make tariff concessions which will stimulate foreign trade because only finished paper products other than news-

print are now subject to import duties, and even on these the rates are not so high as to make them targets for drastic concessions. All classes of pulp as well as newsprint paper, items which make up all but an insignificant fraction of our import trade in this group, are already on the free list. But since replacement of these imports, or even absorption of potential increases without reduction of the existing volume of imports might involve some sacrifice of export trade in other lines, it is desirable to consider briefly the volume and character of our commerce with the principal countries concerned. The element of major significance with respect to imports of these products is the pressure on our markets of newsprint paper and mechanical and sulphite pulps from Canada. Of secondary but rapidly increasing importance is the flow of chemical pulps from northern Europe, especially from Sweden and Finland. A summary of reports of the Department of Commerce covering trade with Canada, Sweden, and Finland, as reported by these countries, is presented in table 17 in order to give a general concept of the situation.

COMMERCE OF THE UNITED STATES WITH CANADA

Canada is one of our greatest export customers; restoration of Canadian-American trade to former levels might prove a great contribution to the welfare of both countries.

It will be seen that in 1933 Canada's imports from all countries were only 27 percent of what they were in 1929, and that her purchases from the United States declined relatively more than those made elsewhere, accounting for only 54 percent of the total in 1933 as compared to 68 percent in 1929. Agricultural products, automobiles, machinery, coal, and petroleum are important items in Canadian imports from this country.

TABLE 17.—*Foreign commerce of Canada, Sweden, and Finland*

[Thousands of dollars]

	Canada ¹		Sweden		Finland	
	1929	1933	1929 ²	1933 ³	1929 ²	1933 ⁴
Imports:						
From all countries.....	1, 298, 993	350, 902	477, 732	189, 370	176, 432	57, 319
Total from the United States.....	893, 585	190, 044	70, 057	19, 451	22, 011	4, 213
Agricultural products.....	149, 146	40, 651	19, 200	6, 335	10, 621	2, 231
Machinery, automobiles, parts, tires, and rubber goods.....	249, 386	29, 688	21, 058	3, 651	3, 899	484
Petroleum products.....	65, 086	19, 777	7, 169	3, 441	2, 663	775
Coal.....	57, 718	19, 275				
Other.....	372, 249	80, 653	22, 630	6, 024	4, 828	723
Exports:						
To all countries.....	1, 152, 416	465, 068	485, 698	186, 393	160, 695	77, 207
Total to the United States.....	492, 686	149, 149	53, 172	22, 703	11, 408	6, 748
Pulp and paper.....	167, 184	67, 947	37, 736	18, 912	9, 366	6, 192
Other.....	325, 502	81, 202	15, 436	3, 791	2, 042	556

¹ Canadian statistics quoted by Department of Commerce.

² From Commerce Yearbook 1931, vol. 2.

³ From Special Circular 303, Division of Regional Information, Department of Commerce.

⁴ From Special Circular 283, Division of Regional Information, Department of Commerce.

Exports from Canada to all countries declined less than her imports during the depression (the 1933 figure being 40 percent of 1929), but here again the share taken by the United States (32 percent in 1933) was more severely restricted than the portion shipped elsewhere. It is significant that exports of pulp and paper, which constituted 46 percent of the total Canadian export to the United States in 1933, held up better than other products. Canada's ability to finance purchases in this country is evidently in a large and increasing degree dependent upon her pulp and paper trade.

On the other hand it is possible that due to propinquity, Canada might continue to obtain much of her needed imports of agricultural products from the United States, whether or not this country curtailed its importation of Canadian pulp and paper. But loss of American markets for pulp and paper might encourage Canada to turn more to the British Empire countries rather than to the United States for her imports.

In 1929 Canada took 9 percent and in 1933 about 6 percent of the agricultural exports of the United States, but through multilateral relations Canada's trade with us may be of greater significance to our agriculture than indicated by the amount we sell direct to her.

There are other reasons besides the importance of forest products in balancing Canada's trade with the United States which might be cited for maintaining an open door in that direction. Following the removal of the tariff on newsprint in 1913, the industry has developed in Canada almost as an integral part of that in the United States. About 80 percent of the capital investment in the Canadian pulp and paper industry is said to have come from this country. Direct investment of American capital in all Canadian industries at the end of 1934 is reported by the Department of Commerce at more than 2.1 billion dollars. Furthermore, Canadian indebtedness in this country amounts to about 1½ billion dollars.

Entirely apart from policies of the Canadian Government tending to stimulate the manufacture of pulp and paper in Canada as against unlimited exportation of the raw material for conversion in the United States, the development of the industry in eastern Canada up to a certain limit was natural and logical. Eastern Canada possesses large areas of forests of the most valuable pulpwood species. These forests are tributary to many streams, for the most part draining south to the St. Lawrence River, and this makes exploitation possible, even though the country is not developed for other purposes. The same streams furnish excellent sources of cheap water power. With a situation of this sort directly north of the principal consuming markets of this country, Canadian competition is not only natural but inevitable.

Costs of conversion in Canada undoubtedly parallel closely those of the United States. The advantages held are large supplies of preferred pulpwood species, available at low cost. But rapid depletion of the more accessible original stands of Canadian pulp timber, increasing costs which will accompany longer drives, and the elements of uncertainty which seasonal woods operations in an undeveloped region entail, will all tend eventually to equalize the competitive situation in favor of the United States.

COMMERCE OF THE UNITED STATES WITH SWEDEN AND FINLAND

Trade with the United States constitutes about 11 percent of all the foreign commerce of Sweden and about 8 percent in the case of Finland, although in 1929 the proportion of their imports coming from the United States was somewhat higher. Both Sweden and Finland have recently had favorable balances of trade with the United States because during the depression their imports declined more rapidly than their exports to this country. Sweden has no bonded debt in the United States, but Finland has about 55 million dollars outstanding here. To offset this, her relatively narrow credit balance of trade with the United States is bolstered by a substantial favorable margin in her trade with all countries.

Almost one-third of Sweden's imports from the United States and about one-half of Finland's are in agricultural products, but together these constituted less than 2 percent of all agricultural exports of the United States even in the peak year of 1929. Petroleum products, automobiles, and machinery are other important items. On the other hand, in 1933 pulp and paper accounted for about 83 percent of Sweden's exports to the United States and about 92 percent of Finland's, these percentages having increased steadily throughout the depression. This means that trade with the United States in pulp and paper has been much less seriously affected by the depression than has been the case with other commodities. Although, because of prevailing low prices, the dollar value of this trade is still far below prevailing levels, it is worth noting that the vigorous recovery now in progress has already carried the tonnage of trade in chemical pulp above 1929 levels.

In this situation the almost uninterrupted increase in the import of sulphate pulp during recent years is of especial interest (see fig. 3). This growth of the sulphate industry abroad is in part a reflection of technical improvement of the quality of pulp and its consequent ability to compete to a larger extent with domestic sulphate pulps. Scandinavian pulps are said to have maintained a certain superiority in quality, particularly with respect to uniformity, for which converting mills will pay a slight premium. This intangible element, which results from more precise manufacturing control, is of definite value in competition.

Swedish and other north European pulp costs are said to reflect lower wage rates in both wood and conversion. To this may be added extremely favorable ocean freight charges, which have permitted pulp from these countries to enter domestic markets in considerable volume. But cost of wood perhaps remains the most important factor and in this element integration with lumber production is doubtless of some significance.

BALANCE BETWEEN PRODUCTION OF PULPWOOD AND AGRICULTURAL CROPS

From the foregoing discussion it is evident that the pulp and paper trade is too substantial a part of our commerce with Canada, Sweden, and Finland at least, to be easily replaced. Furthermore, agricultural products from the United States constitute so large a proportion of the imports of these countries that an increase of their exports of

pulp and paper to us might be reflected in some benefit to our agricultural trade.

It, therefore, becomes a question as to whether it would not be more economical for the United States to use exports of agricultural crops to purchase a large part of its pulp and paper requirements abroad, rather than to grow the necessary pulpwood at home. In support of this idea it might be claimed that the uncertainty of future requirements for pulp, paper and other forest products both here and abroad undermines any program to supply the necessary pulpwood. This argument is based in part on the possibility that continuation of the decline in the use of lumber and a number of other forest products, which has been in evidence in this country for almost 20 years, would release raw material for any increase in pulp and paper requirements that can be economically supplied at home. It discounts estimates of possible future requirements as given in the Copeland Report and fails to recognize that our forests cannot continue to support the normal volume of use without a far reaching program of conservation.

A further argument for continuing to rely on imports of paper and pulp might be found in the possibility that prices may not be high enough to cover the cost of a program of forestry to produce the necessary wood at home. But it is believed that pulp and paper may be produced as cheaply in this country as elsewhere. Our forests, being for the most part further south and in regions of abundant rainfall, present more favorable growth conditions than prevail in Canada or the northern European countries. To a large extent our forests are also readily accessible for economic operation throughout the year. Right through the depression, the American wood-pulp industry has been showing faith in its ability to compete without tariff protection by opening new mills in the South and Pacific Northwest.

Beyond this, a sound program of forestry in the long run should stabilize pulpwood prices on a favorable level rather than to increase costs out of proportion to price. But in any event too much significance cannot be attached to current prices, for with both agricultural and forest crops it is difficult, if not impossible, to draw a satisfactory balance between price and cost of production. Furthermore, the outlook is no less uncertain for agricultural crops than it is for pulpwood.

This question is of especial significance to the South because marketing of the cotton crop is one of the Nation's most serious agricultural problems, while on the other hand the South presents favorable conditions for the production of greatly increased quantities of pulp and paper.

Favorable geographic location and configuration place an enormous forest of species especially suited for the manufacture of sulphate pulp and capable of extremely rapid growth within easy reach of the principal consuming markets. By intelligent integration of pulpwood supply with the production of saw timber it should be possible to keep wood costs in the South on a favorable basis, and if American industry has the efficiency of which it boasts, it should be in the long run capable of producing sulphate pulp at least, and possibly also sulphite pulp, equal in quality to that produced abroad at a cost which will permit free competition in the domestic markets.

The economic welfare of the South is dependent on wise use of its 190 million acres of forest land as well as upon its cotton crop. The

possibility of expanding the pulp and paper industry as an important feature of a program of forest land use might in part at least offset present curtailed foreign markets for cotton. It certainly offers prospects of productive use for eroded or worn out agricultural lands or for areas left idle by enforced reduction of the cotton crop.

Possible continued curtailment of the area devoted to cotton also raises the question of employment for the labor formerly occupied with that part of the crop. This problem might become more acute as a result of the introduction of mechanical cotton picking machines. Industrial employment such as would be afforded by expansion of the pulp and paper industry would contribute to the rehabilitation of the rural population in the South. The number of people who might be given employment in pulp and paper production, however, would not approach the number who might be displaced by mechanization of cotton harvesting and curtailment of crop production. Furthermore, new pulp and paper enterprises will certainly face a period of stiff competition, which emphasizes the need for careful planning and economical organization of both woods and mill operations.

Although the situation with respect to sulphate pulp in the South is very striking, similar considerations with respect to economic land use and opportunity for effective production apply in large measure to other pulps and other sections of the country as well. For example, conditions for obtaining pulpwood at low cost and for efficient manufacture are equally favorable in the Pacific Northwest.

FOREIGN SOURCES OF PULP AND PAPER MAY BECOME INADEQUATE

The United States has been and is the world's greatest paper market, its 126 million people consuming about as much paper as all the rest of the world combined. American per capita consumption of paper, which exceeded 200 pounds a year prior to the current depression, is more than double that of any other country. By contrast, the average per capita consumption for the world as a whole in 1925-27 was only about 23 pounds.

WORLD PAPER CONSUMPTION INCREASING

It is believed that the dominant position of the United States in respect to paper use, even when liberally discounted for the special conditions which have obtained here, is some indication of enlarged future consumption for the world as a whole. Liberal use of paper is apparently associated with advanced stages of modern industrialization. Contrary to what might have been expected industrialization of the countries in western Europe and North America brought with it a greatly increased use of wood. Initial demands for lumber which have subsequently receded in the United States, were followed by increased use of paper, especially in the United States where the modern trend in industrialization has gone furthest. The increase of world trade in pulp and paper which was interrupted by the depression of recent years has apparently begun to reassert itself.

What the possibilities are in this direction may be indicated by the per capita rates of consumption in various countries shown in table 18. It is significant that there is a wide gap between consumption in the industrial nations of northwestern Europe and North America and other parts of the world for which statistics are available. Recent

years have seen a striking increase in paper consumption in Japan. Modern industrial development of other oriental countries would certainly stimulate an additional demand for pulp and paper which might eventually, although perhaps slowly, assume large proportions.

Substantial possibilities are also developing in Russia. Efforts at industrialization of Russia increased the total cut of all classes of wood 125 percent between 1925 and 1930, or from 25 to 54 cubic feet per capita and estimated requirements for 1940 are more than double those of 1930. What this means in terms of pulp and paper can only be guessed by considering the phenomenal increase in literacy now in progress in relation to an annual paper consumption of only 6 pounds per capita in 1925-27. With mill capacity far below potential market demands, it is not improbable that consumption of paper in Russia is being held down by inability to finance purchases abroad on a larger scale.

TABLE 18.—*Annual per capita consumption of paper in various countries, 1925-27*

	Consumption per capita (pounds)
United States.....	192
Canada.....	92
England.....	92
Sweden.....	68
Germany.....	59
Denmark.....	58
Belgium.....	51
Norway.....	42
Netherlands.....	42
Finland.....	41
Austria.....	39
Italy.....	22
Japan.....	17
Estonia.....	12
Poland.....	9
Greece.....	8
Yugoslavia.....	8
Russia.....	6
Rumania.....	5

The possibilities for further growth would appear to be greater in other parts of the world than in the United States yet possible future paper requirements of this country have been placed for purposes of planning at double the consumption of recent years. World paper consumption may perhaps increase from 20 to 60 million tons in a few decades, as predicted by Bernard Navarre, president of the Association of Paper Manufacturers of France, at the International Forestry Conference in Paris in 1931. But that the rest of the world will keep pace with the United States is perhaps the more conservative view.

WORLD TIMBER SUPPLIES DIMINISHING

In the face of such possible if not probable increases of world paper consumption it appears that world timber supplies, especially of the sorts most commonly used for pulp, are decreasing. The coniferous forests of the North Temperate Zone, which supply the greater part of the world's timber needs, are being depleted at an alarming rate, and only a few countries still have supplies in excess of their own needs. Norway, Germany, Austria, and other countries

of central and southeastern Europe cannot long keep up their present rate of exportation if they are to satisfy their own requirements; in fact, the pulp industries in most of these countries now depend on wood imported from Russia to a large extent. Canada, Newfoundland, Sweden, Finland, and Russia are the only countries which offer prospect of supplying export markets in large volume for any considerable period.

In Canada cutting is said to be progressing at a rate far above annual growth and remaining supplies are becoming relatively inaccessible and more expensive to utilize but Boyce estimates that pulp production may perhaps be increased another 4,000,000 tons annually.

Production of pulp and paper has increased at a rapid rate in Newfoundland during the past decade, exports of newsprint paper exceeding 300,000 tons in 1934. But considering the limited area of available forest and its northern location, it is probable that cutting is now much in excess of sustained yield capacity, and that Newfoundland will not be a much larger factor in world pulp and paper trade.

In Russia, with an estimated two-fifths of the world's coniferous forest area, readily accessible timber is being cut recklessly and uncontrolled fires are rendering large areas unproductive. Even here the rising wave of domestic paper use is likely to tax Russia's pulp productive capacity for many years and prevent her from contributing, except in the form of pulpwood, to world markets on a large scale. According to Boyce, development plans are apparently aimed chiefly at supplying domestic needs although forced exports of wood may continue to be an important and uncertain factor.

Both Sweden and Finland have the resources to continue or even increase substantially their exports of pulp or pulpwood. Sweden's annual cut is estimated by Ilvessalo and Jalava to be well within annual growth and it should be possible to divert a much larger proportion of forest growth, especially pine, to pulp rather than lumber. Although Finland is thought to be overcutting her softwood growth from 15 to 20 percent, this does not imply an eventual curtailment of production, because growth may increase as original undeveloped forests are opened up. Furthermore, according to Slesinger, pulpwood production in Finland may be increased by a reduction in the extremely high consumption of the fuel wood. Boyce has estimated that Sweden and Finland might increase their pulp exports by some 3,000,000 tons each.

The probable extent of future world timber consumption and current overcutting in the pulpwood forests of some of the principal exporting countries, notably Canada, Russia, and Norway, point definitely toward restricted supplies, increasing world competition for pulpwood requirements, and higher prices for the long-term outlook. The present economic situation in the world timber trade indicates that our domestic market will not be under pressure indefinitely from a flood of cheap foreign pulp and paper. It is quite possible that unless provision is made for producing and manufacturing the necessary pulp at home, the United States might find itself, in the not too distant future, a competitive buyer for inadequate supplies of pulp and paper in advancing world markets.

INDEPENDENCE WOULD AFFORD STABILITY TO DOMESTIC INDUSTRY
AND ASSURANCE OF ADEQUATE FUTURE SUPPLIES

Production facilities in the exporting countries of Europe have been increased during the past few years. To the extent that such expansion of the pulp industry abroad goes beyond the needs of other countries in order to supply the large market of the United States, it will be increasingly difficult to maintain the industry we now have, to say nothing of building it up to meet any part of increased future needs. For the foreign industry, thus expanded, will have strong incentive to make drastic concessions in order to capture and hold our market.

Permitting the proportion of imports to assume major importance in any group of products subjects our markets and industries to the dominance of foreign producers. The demoralizing effects of such dominance has been painfully demonstrated in the newsprint industry during the past decade. This unfortunate situation was probably unavoidable in view of past dependence of this industry on spruce pulpwood, but repetition of such a process for other products, such as sulphate pulp, would indeed seem unnecessary and unwise.

Although vigorous competition from abroad may be welcomed by paper mills which purchase their pulp from abroad, the advantage to them may be transient and offset by uncertainty should foreign supplies either become inadequate or assume much larger importance in our markets. So long as the country depends upon imports for a major part of its pulp and paper requirements, its source of supply will be subject to adverse action of foreign governments, political disturbance abroad, the uncertain influences of foreign exchange, or curtailment during periods of war. On the other hand, if the country is self-supporting in respect to these products, it might by proper planning insure an adequate and stable supply of raw material for all its needs.

LONG-RANGE PLANNING REQUIRED

Dependence on imports without provision for forest conservation may lead to serious and prolonged maladjustments in paper requirements should foreign sources later prove inadequate. Not only would it be impossible to rehabilitate depleted forests without a long-time program of conservation, but also years would be required to enlarge pulp and paper manufacturing plant capacity in proportion to prospective future requirements. Adequate provision for future needs can only be assured by initiating a comprehensive program of forest conservation and expansion of industry looking toward a large measure of future self-sufficiency but conceived and executed with due regard for agriculture and other aspects of our national life.

Such a program would seem to be wise public policy, although it may involve some adjustment of our foreign trade, because expansion of pulp-mill capacity in this country has proceeded even during the years of the depression, and indications are not lacking that new installations will continue. The pulp and paper industry, especially in the South and the Pacific Northwest, seems likely to forge ahead in the next few decades without reference to Government aid or encouragement, or other considerations.

This being the case a far-sighted program of forestry and land use is desirable to guide expansion of the industry, to prevent unnecessary wrecking of productive forests and to insure stability, permanence, and a maximum of concomitant economic benefits from such expansion. Restoration of depleted forests is a long, slow process and much more costly than planned conservation of productive capacity through sustained yield management.

Planned expansion of the pulp and paper industry in this country, at least to keep abreast of increased demands for the future, would not only advance the national program of conservation largely by providing markets for certain products but also would contribute beneficially to other basic policies of the Government looking toward social and economic security.

It might eventually contribute directly toward economic use for from 100 to 200 million acres of forest land; it might provide substantial support for many rural-industrial communities in several sections of the country; it might aid agriculture by affording farmers a market for their woodland products and otherwise; while possibly reducing the opportunities for employment in export industries it might provide an enlarged source of industrial employment in certain regions especially in the South and Pacific Northwest where new avenues of industrial activity are much needed; and it would represent the logical development of a natural resource industry in which efficient production may be expected.



UNITED STATES DEPARTMENT OF AGRICULTURE

LIBRARY

WASHINGTON, D. C.

OFFICIAL BUSINESS

U.S. Dept. of agriculture.

National pulp and paper requirements in
relation to forest conservation.

1
Ag86Na

rs.

PENALTY FOR PRIVATE USE TO AVOID
PAYMENT OF POSTAGE, \$300.

U.S. Dept. of Agriculture
Ag86Na
1

